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FLOOD PLAIN INFORMATION. MENDENHALL RIVER, JUNEAU, ALASKA. (U)
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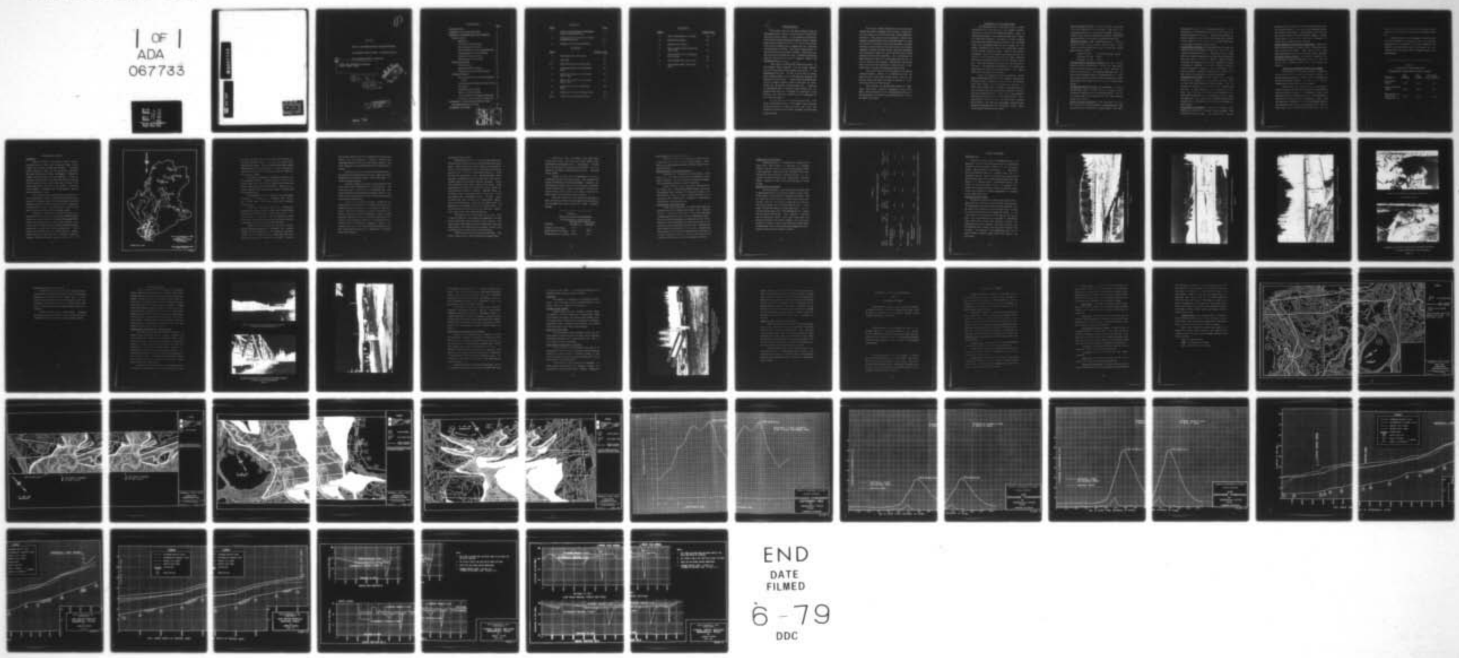

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NOTE

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(6) Flood Plain Information. Mendenhall River, Juneau, Alaska.

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ABSTRACT

INTRODUCTION

This report relates to the flood situation along the Mendenhall River, which is located about 8 miles northwest from Juneau, Alaska. It was prepared at the request of the Greater Juneau Borough through the State of Alaska, Department of Natural Resources, to aid in the solution of local flood problems and to suggest the best utilization of land subject to overflow. This report is based upon information concerning rainfall, snowfall, runoff, historical and current flood heights and other technical data bearing upon the occurrence and size of potential floods in the Mendenhall River area.

ABSTRACT

This report covers several significant aspects of the potential flood problems. It first brings together a record of the largest known floods of the past in the Mendenhall River area. Second, it deals with the probability of future floods, such as Intermediate Regional and Standard Project Floods. Intermediate Regional Floods have an average frequency of once in 100 years as determined from an analysis of known high water conditions on Mendenhall River. Standard Project Floods are the largest floods that may reasonably be expected to occur. However, they should be considered in the planning for use of the flood plains.

In view of the need to control the use of the flood plains of Mendenhall River and to guide future development in the area this study develops the size and frequency of both the Intermediate Regional and Standard Project Floods.

This report contains maps and cross sections which indicate the extent of flooding which has been experienced or which might occur in the future in the vicinity of Mendenhall River. The graphic map presentation should prove helpful in planning the best use of the flood plain. By using this report it is possible to determine the depth of probable flooding in any location by occurrence of the Intermediate Regional or Standard Project Floods. With this information local planning to control the use of the flood plain through zoning and subdivision regulations, the construction of flood protection works or a combination thereof may be used to minimize flood damage. Unprotected construction below predicted flood elevations is done with full recognition of the risks and of flooding hazards involved.

This report does not include plans for the solution of flood problems. Rather, it is intended to provide the basis for future study and planning on the part of the Greater Juneau Borough in arriving at solutions to minimize vulnerability to flood damage.

Upon request, the Alaska District Corps of Engineers, will provide technical assistance to Federal, State, and local agencies in the interpretation and use of the information contained herein and will provide other available related data.

SUMMARY OF FLOOD SITUATION

The Mendenhall River flood plain area is 8 miles northwest of the City of Juneau, the capital of Alaska. The City of Juneau is the largest population center in Southeastern Alaska. It is centrally located with respect to a large block of timber. This block of timber includes that part of the Tongass National Forest on the mainland from, and including the Endicott Arm drainage on the south, to Skagway on the north, all of Admiralty Island, and the smaller adjacent islands. Most of the area is mountains, which rise abruptly from sea level to an elevation of several thousand feet near the coast, attaining elevations to 8,000 feet along the divide to British Columbia. The last remnants of the great ice cap still exist in this area. Any additional development in the Juneau area would encroach on the flood plains because the higher flood free areas have been developed.

The U. S. Geological Survey maintains a stream gage on Mendenhall River near the outlet of Mendenhall Lake and a gage on Montana Creek near the Mendenhall Loop Road Bridge. Since both gages were installed in 1965, earlier flood history is sparse. Residents were interviewed and historical documents searched for information concerning past floods. From these investigations and from theoretical studies of possible floods on Mendenhall River and its tributary, the local flood situation has developed. The following paragraphs summarize the significant findings which are discussed in more detail in succeeding sections of this report.

THE GREATEST FLOODS of which we have knowledge occurred in September of 1927 and 1943. There was no substantial damage as a result of these floods. However, if these floods occurred today there would be substantial damage because of increased development in the area.

ANOTHER FLOOD in the Mendenhall River valley is known to have occurred in 1961. Other high flows recorded for Mendenhall River taken from the stream gage installed in 1965 are:

August 24, 1966	8,900 cubic feet per second
September 15, 1967	9,020 " " " "
September 7, 1968	7,580 " " " "

INTERMEDIATE REGIONAL FLOODS have an average frequency of once in 100 years. They are determined from an analysis of the stream and other streams in the same general area. The analysis indicates that the Intermediate Regional Flood for Mendenhall River would have a water surface elevation of 60.4 feet at the Upper Mendenhall River Bridge and 25.0 feet at Brotherhood Bridge.

STANDARD PROJECT FLOOD determinations indicate that flooding, under a combination of most severe conditions, would occur in the Mendenhall River area at an average depth of 3 feet higher than the Intermediate Regional Flood.

MAIN FLOOD SEASON for Mendenhall River is August through November. Most floods and high water flows have resulted from rainfall with a base flow.

Mendenhall River is fed by Mendenhall Glacier at its headwaters in Mendenhall Lake which contributes to the high summer base flow. Large floods caused by intense rainfall can occur any time during the summer or early fall, however there is a period of high water every spring caused by melting snows.

VELOCITIES OF WATER during major floods range up to 18 feet per second (about 12.3 miles per hour) in the channel of Mendenhall River. Velocities on the flood plain vary widely, depending on location; but are generally less than 3 feet per second. During floods current directions and velocities can change rapidly as a result of changes in conditions; thus main channel velocities could be attained in overbank areas. Velocities of 3 feet per second or greater combined with depths of 3 feet or more are generally considered hazardous.

DURATION OF FLOODS. During a flood, the stream would rise rapidly to an elevation of 55 feet in the vicinity of the Upper Mendenhall River Bridge and an elevation of 25 feet in the vicinity of Brotherhood Bridge, at which stage the river would go over the bank. Any rise above that elevation would be relatively slow because of the relief afforded by the large overbank area. The Intermediate Regional Flood and the Standard Project Flood both would be out of banks for about 4 days.

HAZARDOUS CONDITIONS would occur during large floods as a result of the rapidly rising stream, high velocities and deep flows. An additional hazard

during a flood is presented by floating logs and trees which can destroy buildings, cause jams, erode banks,and change the location of the channel. This floating debris can also pile up on the banks in an unpredictable manner, causing rapid changes in direction of water flow, velocities and an increase in predicted water surfaces.

FLOOD DAMAGE PREVENTION MEASURES. There have been no flood damage prevention works constructed in the area covered by this report. Also, there are no flood plain regulations in effect in the Greater Juneau Borough.

FUTURE FLOOD HEIGHTS that would be reached if the Intermediate Regional and Standard Project Floods occurred on Mendenhall River are shown on Table 1.

GENERAL CONDITIONS AND PAST FLOODS

This section of the report includes a general description of the study area and a history of floods on Mendenhall River together with a discussion of the prevailing flood situation. It covers in detail obstructions to flood flows in the study area.

The portion of the drainage basin covered by this report consists of the flood plains adjacent to and including the area from the confluence of Mendenhall River with Gastineau Channel to Mendenhall Lake. It also incudes the flood plains adjacent to and including the area from the confluence of Montana Creek with Mendenhall River to the Montana Creek Bridge on Mendenhall Loop Road. Although both Jordan and Duck Creeks are in the

flood plain they are not included in the study. Neither stream is considered to be susceptible to extensive flooding.

Although there are few newspaper accounts or other records of flooding in the flood plain, photos were obtained showing the river at bankfill or overbank conditions. The probable area of inundation used for this report was developed from earlier data, field investigations and office computations.

TABLE 1
RELATIVE FLOOD HEIGHTS AT
MENDENHALL RIVER AND MONTANA CREEK

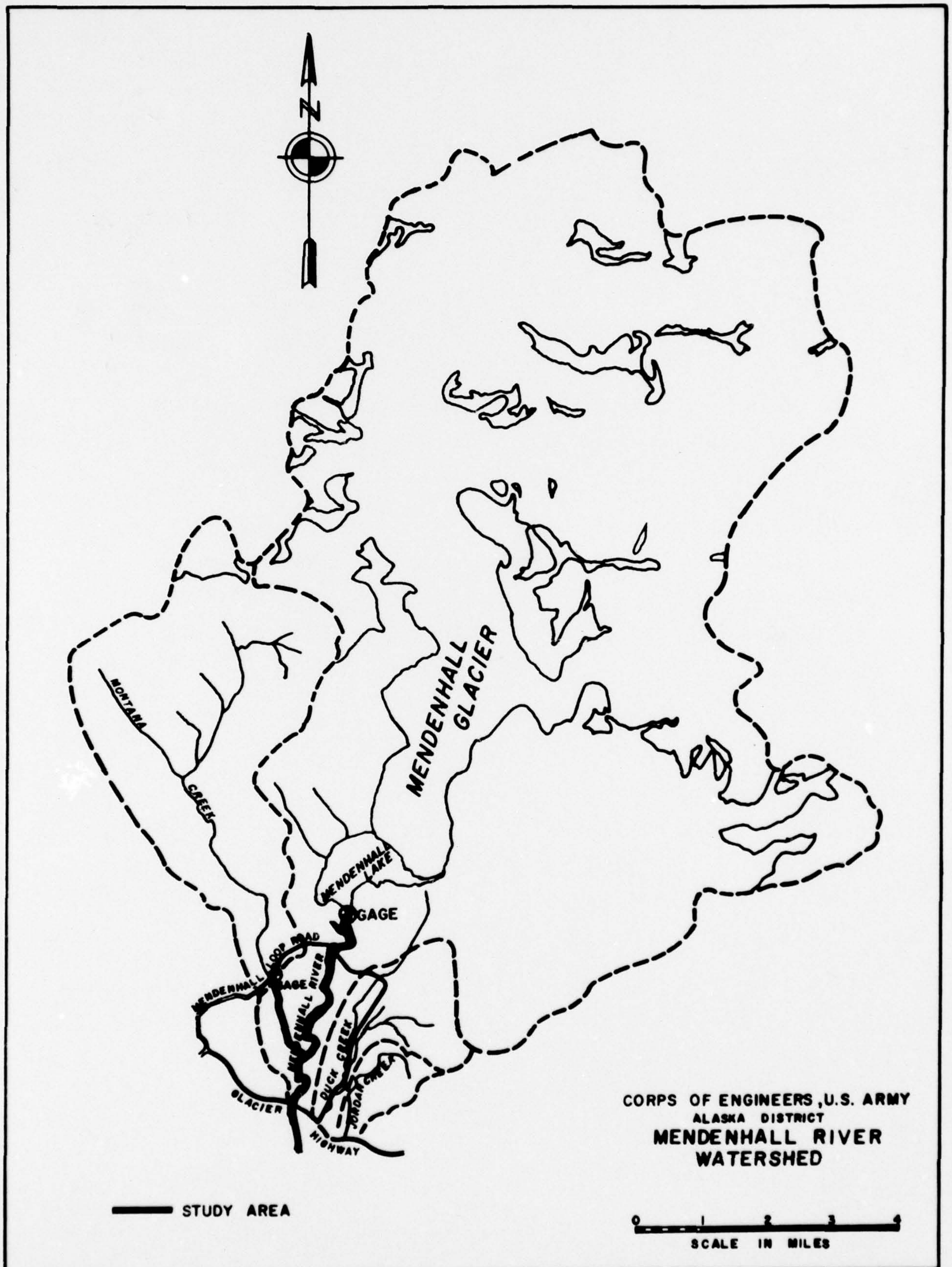
Location	IRF (ft MSL)	SPF (ft MSL)	Streambed Elev. (ft MSL)
Brotherhood Bridge	25.0	29.8	8.0
Upper Mendenhall Bridge	60.4	64.1	42.5
Mendenhall Loop Road Bridge (Montana Creek)	49.0	50.0	40.0

Settlement

Juneau is Alaska's capital and its third largest population center. Often called America's most scenic capital, the city lies on Southeast Alaska's sheltered Inside Passage, 75 miles from the open ocean and about 900 miles northwest of Seattle, Washington. Behind the capital rises Mt. Juneau and Mt. Roberts, in front is Gastineau channel, and to the north and south the fingers of the mainland ice field reach to the fjord-cut coast. The channel separates Juneau from the smaller residential city of Douglas. A bridge and a short highway provide access between the cities.

The valleys in which Juneau and its suburbs lie were originally part of the territory of the Tlingit Indian Nation. The Tlingits had one of the most highly developed aboriginal cultures in North America, with a prosperous economy based on the abundant forest, fishing and mineral resources of the Southeast Alaska region.

Although the Hudson Bay Company operated a fur trading post south of Juneau on Taku Bay from 1841 to 1843, the area was not permanently settled by whites until 1880. In 1879 Joe Juneau and his partner, Richard Harris, discovered gold, and Harrisburg, later to be named Juneau, sprang up as a gold rush town near that area. More discoveries followed and the Treadwell Mine on Douglas Island became the largest producer of gold in Southeast Alaska. Juneau was the gold mining center of the



N
MONTANA
CREEK
MENDENHALL
GLACIER
MENDENHALL
LAKE
GAGE
MENDENHALL LOOP ROAD
GAGE
MENDENHALL RIVER
DUCK CREEK
JORDAN CREEK
GLACIER
HIGHWAY
STUDY AREA
CORPS OF ENGINEERS, U.S. ARMY
ALASKA DISTRICT
MENDENHALL RIVER
WATERSHED
0 1 2 3 4
SCALE IN MILES

PLATE I

territory until gold rushes into Alaska's interior began in the early twentieth century. As the city grew, other industries flourished. These included salmon and halibut fishing; lumbering and farming for local consumption. Juneau incorporated as a city and was made the capital of the territory in 1900.

Gold mining continued to bring new people into the area through the 1930's. Significant gold production ended in 1944 when the last of the large mines in the area closed under pressure of World War II. After the war, growth resumed with expanded government activities and increased tourism.

The population of the Juneau area has steadily increased over the years, as indicated: 1910 - 3,472; 1920 - 4,723; 1950 - 7,789; 1960 - 9,745; 1965 - 12,418 and 13,556 in 1970.

Juneau was the supply center for southeastern Alaska until shipments direct to other ports via the Marine Highway Ferry System began in 1963. However, the ferry service to Juneau in 1963 increased the number of tourists approximately 50 percent with total estimated expenditures by tourists in 1965 being $707,000.

Juneau lies in the midst of one of the world's largest remaining supplies of softwood. As a result, Juneau has been selected as the location in Southeast Alaska for the construction of a large pulp mill and a sawmill. These new industries will greatly increase

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the need for additional service organizations and housing, both private and commercial. Fishing remains a very important industry to the area, and salmon, halibut, king crab, dungeness crab and bottomfish are all processed in Juneau.

Minerals are also an important possibility as there are large but low grade deposits of iron, copper and nickel. Should the price of gold increase, mining would again become a principal industry.

The main industry in Juneau is government. In 1965 53 percent of total employment was in government, one third at the state or local level. It is estimated that with the growing State and Borough governments, the area may expect an average increase of from 4 to 8 percent annually in government employment.

As part of the Southeast Region, Juneau has the natural resources necessary for a diversified economy and should increase its attraction as a location for new enterprises. Snettisham hydroelectric project, now under construction, will have a power installation of about 70,000 kilowatts. Mountains and water limit the usable land in the Juneau area, but enough remains to accommodate foreseeable growth of population or industry. Most of the available land lies in the flood plains and therefore will take considerable planning and regulation to eliminate future flood damage.

The Stream and Its Valley

Mendenhall River has its origin in Mendenhall Lake about ten miles west of Juneau and drains about 103 square miles. Approximately 42 square miles or 40 percent of the area in the Mendenhall River watershed is covered by glaciers. One of these, Mendenhall Glacier, feeds directly into Mendenhall Lake. Mendenhall River flows generally southward for approximately five miles and eventually drains into Gastineau Channel. Montana Creek which originates in the upper slopes of the basin, flows southeasterly and flows into Mendenhall River about 3/4 mile upstream of Glacier Highway. Montana Creek is oriented in such a direction that it receives less precipitation than Mendenhall River. It is at a lower elevation and does not have any appreciable glacier area in the headwaters. Also, peak runoff from the Montana Creek drainage area has a shorter time of concentration and therefore does not contribute materially to the peak flow for Mendenhall River.

Elevations in the basin range from sea level to almost 7,000 feet. The valleys are generally very deep and narrow and the stream slopes are very steep. The upper slopes of the valley are largely impervious with very little topsoil. The valley floors are densely covered with vegetation and are relatively flat near the mouth.

Table 2 shows the drainage area in the basin and glacier covered area. Plate 1 shows the drainage basin.

The primary cause of flooding is the rapid runoff during heavy rains. The most severe flood known to date was observed in September 1927. The highest recorded flow rate was observed in September 1967 after stream gages were installed on Mendenhall River and Montana Creek in 1965.

Floods can occur from a combination of factors, including snow melt and precipitation. The sequence of events also affects the flooding potential. Summer and fall floods can result from an extreme amount of rainfall in a short period of time. High temperatures in the glacial areas or warm rain on snow or ice fields contribute to higher base flows during the summer months.

All known floods have not caused great damage to date, but with uncontrolled development in the flood plains it is inevitable that future floods will cause extensive damage.

TABLE 2

DRAINAGE AREAS IN WATERSHED OF MENDENHALL RIVER BASIN

Location	Drainage Area (Sq. Mi.)	Glacier Area (Sq. Mi.)
Montana Creek at gage	14.6	
Mendenhall River at gage	85.1	41.6
Mendenhall River at mouth	102.8	41.6

Flood Damage Prevention Measures

There have been no flood damage prevention works constructed in the area covered by this report. Also, there are no flood plain regulations in effect in the Greater Juneau Borough.

Flood Warning or Forecasting Services

Forecasts for precipitation, temperature, cloud cover, etc., are issued routinely by the Weather Bureau Office in Juneau. Special warnings are issued for emphasis on impending hazardous weather conditions.

Intense rainfall criteria have been established for the Juneau area, including Mendenhall River, for use in issuing flash flood warnings. This type of warning is the most effective means of public warning because of the extremely fast runoff on the small and steep basins characertistic of the Juneau area.

Development in the Flood Plain

Plate 2 is an index map of 3 sheets which show the potential flood area of Mendenhall River and Montana Creek. Plates 3 through 5 show the flood plain of Mendenhall River for the reach covered by this report. There is limited development existing in the flood plain. However, with the building of the new pulp mill and a saw mill there will be increasing need for new construction, both commercial and private. The area surrounding Mendenhall River is prime development land necessary to Juneau's expanding economy. The use of this land must be carefully controlled to avoid flood damage in the future.

Bridges Across the Stream

Mendenhall River is crossed by two bridges in the study reach. Both bridges are classified as highway bridges. Montana Creek is crossed by one highway bridge in the study area. Table 3 lists the pertinent elevations, location for these structures, and their relation to the crest of the Standard Project and Intermediate Regional Floods. Figures 1, 2 and 3 show photographs of the bridges.

Obstructions to Flood Flow

The only natural, major obstructions to flood flow in Mendenhall River are the sharp meanders. The effect of the bridges on flood flow was discussed previously. Old car bodies have been strewn on a bank of the river to curb erosion. However, the manner in which the car bodies were placed would serve no useful purpose and could cause considerable damage during high water. Swift currents during high water could dislodge the car bodies and move them downstream. This condition combined with accumulation of debris could create large jams and produce backwater and channel changes. The occurrence of jams at bridges or large jams along the main channel of Mendenhall River would appreciably increase the water surface profiles shown on Plates 9 and 10.

TABLE 3

BRIDGES ACROSS MENDENHALL RIVER

Miles Above Mouth	Identification	Stream Bed Elev. (ft)	Road Surface Elev. (ft)	IRF Flood Crest (ft)	SPF Flood Crest (ft)	Underclearance Elev. (ft)
Mendenhall River						
1.0	Brotherhood Bridge	8.0	38.5	25.0	29.8	32.2
4.4	Upper Mendenhall Bridge	42.5	66.8	60.4	64.1	63.4
Montana Creek						
1.3	* Mendenhall Loop Road Bridge	40.0	53.1	49.0	50.0	50.7

* Elevations of water surfaces at this bridge are tentative since backwaters were terminated downstream of the bridge opening.

FLOOD SITUATION

Flood Records

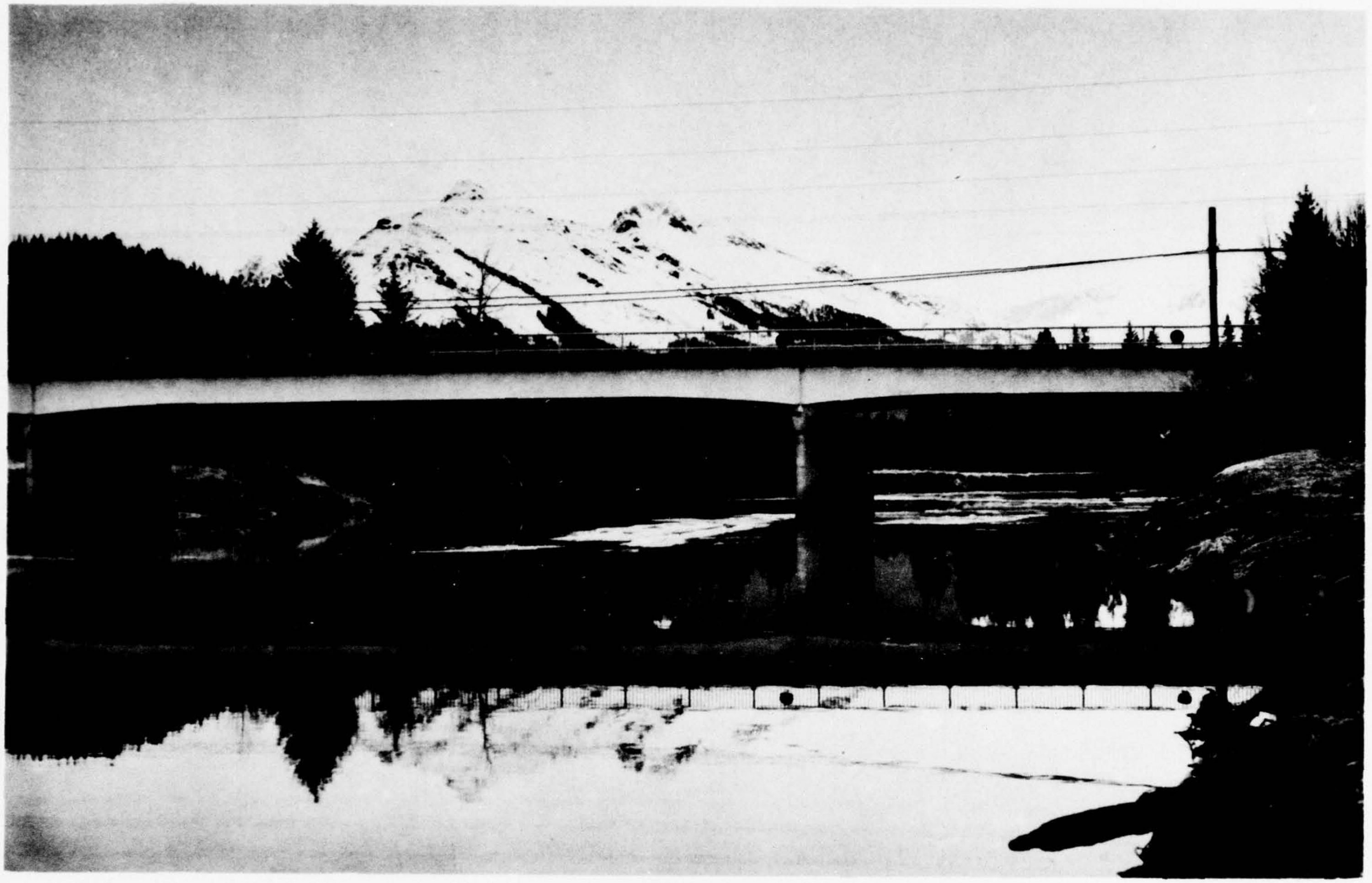
Records of stream flows on Mendenhall River and Montana Creek have been maintained since the installation of gages on these streams in 1965 by U. S. Geological Survey. Miscellaneous measurements of Mendenhall River and Montana Creek are available from the U. S. Geological Survey. These records have been supplemented by interviews with local residents, photographs of previous floods, U. S. Weather Bureau rainfall data and tide data from U. S. Coast & Geodetic Survey. By using the foregoing records and correlating weather records with flows, it has been possible to develop a knowledge of flooding on the Mendenhall River.

Duration and Rate of Rise

The general shape of the upper basin dictates that a flood would have a sharp rise and a relative short duration. The Mendenhall Lake would route down the peak flow from the upper valley; however, since the outlet is the location of a measurement and the area below the mouth is the critical area, the discharge from the lake is the critical peak. The peak discharge from the outlet of Mendenhall Lake would suffer normal peak attrition; however, the additional inflow from Montana Creek and the local area of Mendenhall River would more than offset the peak flow attrition. The peak flow for the Mendenhall River at the mouth would be slightly higher than for the peak at the lake outlet.

UPPER MENDENHALL RIVER BRIDGE ON THE LOOP ROAD

Figure 1



BROTHERHOOD BRIDGE ON GLACIER HIGHWAY

Figure 2

BRIDGE CROSSING MONTANA CREEK ON MENDENHALL LOOP ROAD
Figure 3

VIEW OF CAR BODIES USED FOR RIPRAP ON

AN ERODING BANK

METHOD OF PLACING CARS WILL NOT STOP EROSION

- IT DOES INCREASE FLOOD HAZARD

Figure 4

Flooded Areas and Cross-Sections

Plates 3 through 5 show the areas along the Mendenhall River that would be inundated by the Intermediate Regional and Standard Project Floods. The actual limits of these overflow areas on the ground may vary somewhat from those shown on the maps, since their scale is such that precise plotting of flooded areas is not possible.

Plates 11 and 12 show cross-sections obtained during surveys made in 1969 with water surface elevations of Standard Project and Intermediate Regional Floods.

* * *

FUTURE FLOODS

This section of the report discusses the Standard Project Flood and the Intermediate Regional Flood on the Mendenhall River along with some of the hazards of great floods. Floods the size of the Standard Project Flood represent the reasonable upper limits of expected flooding. Those the size of the Intermediate Regional Flood represent floods that may reasonably be expected to occur more frequently, although they will not be as high as the Standard Project Flood. While they have not been known to occur, there is reason to believe that they could occur in the future. In determing these types of floods consideration was given to topography, watershed cover, and the physical characertistics of the stream.

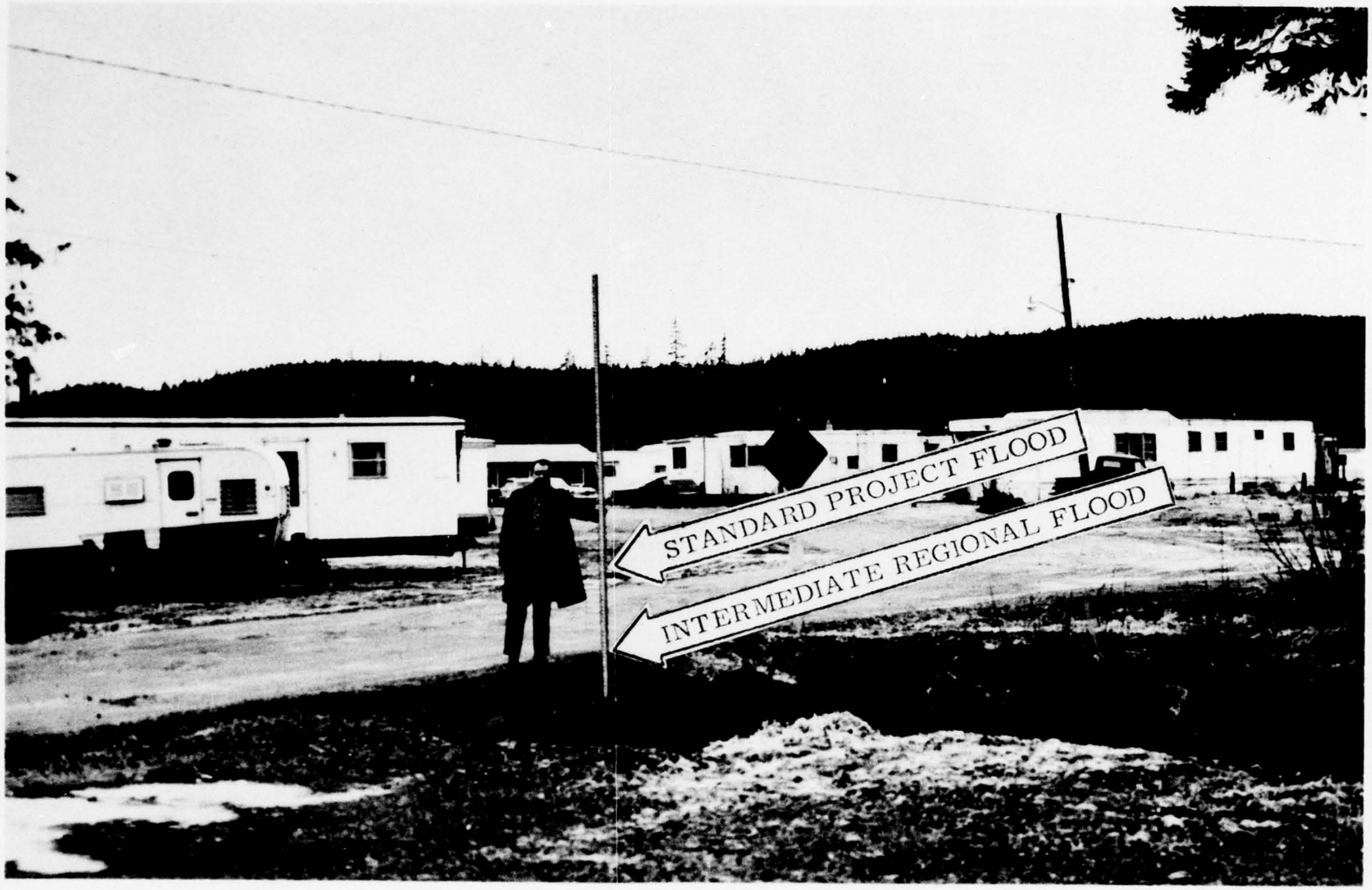
Determination of Intermediate Regional Flood

The Intermediate Regional Flood is defined as a flood at any given location having average frequency of occurrence of once in 100 years, although the flood may occur in any year. Frequency estimates are generally based on a statistical analysis of stream flow records available for the watershed under study. However, limitations in such records usually require analysis of rainfall and runoff characteristics in the general region of the area under study. The Intermediate Regional Flood represents a major flood, although it is much less severe than the Standard Project Flood.

Streamflow records of the U. S. Geological Survey at stations on Mendenahll River and Montana Creek, plus

VIEW OF OLD LOWER MENDENHALL BRIDGE
-FLOOD OF SEPTEMBER 1927

DEBRIS STARTING TO COLLECT AGAINST BRIDGE
-FLOOD OF SEPTEMBER 1927
Figure 5



FLOOD HEIGHTS AT TRAILER COURT NEAR DUCK CREEK
Figure 6

miscellaneous measurements on portions of Mendenhall River, were used in deriving the Intermediate Regional Flood. The precipitation amounts with their specified frequencies were used along with streamflow records. The precipitation amounts and temperature data are published by the U. S. Weather Bureau.

The results of statistical analysis and electronic computer calculation indicates that the Intermediate Regional Flood peak discharge for Mendenhall River is 32,000 cubic feet per second, resulting in a water surface elevation of 60.4 feet at the Upper Mendenhall River Bridge and 25.0 feet at Brotherhood Bridge. A discharge hydrograph of the Intermediate Regional Flood is shown on Plate 7.

Determination of Standard Project Flood

Only in rare instances has a specific stream experienced the largest flood that is likely to occur. Severe as the maximum known flood may have been on any given stream, it is commonly accepted that eventually a larger flood can and probably will occur. A Standard Project Flood is defined as the largest flood that can be experienced from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical region involved.

The Standard Project Flood for Mendenhall River is estimated to have a peak discharge of 57,000 cubic feet

per second at the mouth. A discharge hydrograph of the Standard Project Flood is shown on Plate 8.

Frequency

No frequency is assigned to the Standard Project Flood. The occurrence of such a flood would be a rare event; however, it could occur in any year.

Possible Larger Floods

Floods larger then the Standard Project Flood are possible, but the combination of factors that would be necessary to produce such floods would seldom occur. The consideration of floods of this magnitude is of greater importance in some problems than in others, but should not be overlooked in the study of any problem.

Hazard of Great Floods

The amount and extent of damage caused by any flood depends in general upon how much area is flooded, the height of flooding, the velocities of flow, the rate of rise, and the duration of flooding.

Areas Flooded and Heights of Flooding

The area around the Mendenhall River subject to flooding by the Standard Project and Intermediate Regional Floods are shown on Plates 3 through 5. Depths of flow can be obtained by subtracting the elevation at the point desired from the flood elevation.

The profiles for the streams were computed by using stream characteristics for selected reaches as determined from observed flood profiles, topographic

FLOOD HEIGHTS BETWEEN SECTIONS 11 AND 12
NEAR THE RIVER LOOKING SOUTHWEST
(See plate 2 for photo location)
Figure 7

maps, and valley cross sections which were surveyed in 1969. The elevations shown on Plate 2 and the overflow areas shown on plates 3 through 5 have been determined with an accuracy consistent with the purposes of this study and the accuracy of the basic data. The profiles of the Standard Project and the Intermediate Regional Floods depend in part upon the degree of destruction or clogging of various bridges during the flood. Bridges that are particularly affected by these flows are discussed on Page 12.

Velocities, Rates of Rise, and Duration

Water velocities during a flood depend largely upon the size and shape of the cross-sections, the conditions of the stream, and the streambed slope. The maximum velocities that would occur in the main channel on Mendenhall River would range up to 12 feet per second during Intermediate Regional Floods. The maximum velocities that would occur in the main channel for the Standard Project Flood would range up to 18 feet per second.

Plates 11 and 12 show cross-sections typical of the ones used for the Mendenhall River study. The elevations and extent of overflow of the Intermediate Regional and Standard Project Floods are indicated on these sections.

AUTHORITY, ACKNOWLEDGEMENTS,

AND

INTERPRETATIONS

This report has been prepared under the authority of Section 206 of the 1960 Flood Control Act (Public Law 86-645), as amended by Section 206 of the 1966 Flood Control Act (Public Law 89-789).

* * *

The assistance and cooperation of the U. S. Weather Bureau, U. S. Geological Survey, U. S. Forest Service, Department of Natural Resources, State of Alaska and the Greater Juneau Borough for supplying information used in the preparation of this report are gratefully acknowledged.

* * *

This report presents the local flood situation for the Mendenhall River valley and vicinity. The Alaska District of the Corps of Engineers will, upon request, provide interpretation and limited technical assistance to Federal, State, and local agencies and will provide other available flood data related thereto.

GLOSSARY OF TERMS

Flood. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or stream or an ocean, lake, or other body of standing water.

Normally a "flood" is considered as any temporary rise in stream flow or stage, but not the ponding of surface water that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased stream flow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Peak. The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest.

Flood Plain. The relatively flat area or low lands adjoining the channel of a river, stream or watercourse, or ocean, lake, or other body of standing water which has been or may be covered by flood water.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Head Loss. The effect of obstructions, such as narrow bridge openings or buildings that limit the area through which water must flow, raising the surface of the water upstream from the obstruction.

Intermediate Regional Flood. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the "general region of the watershed."

Left Bank. The bank on the left side of a river, stream, or watercourse, looking downstream.

Low Steel (or Underclearance). See "underclearance."

Right Bank. The bank on the right side of a river, stream, or watercourse, looking downstream.

Standard Project Flood. The flood that may be expected from the most severe combination of meteorological

and hydrological conditions that is considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40% or 60% of the Probably Maximum Floods for the same basins. The terms, as used by the Corps of Engineers, are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

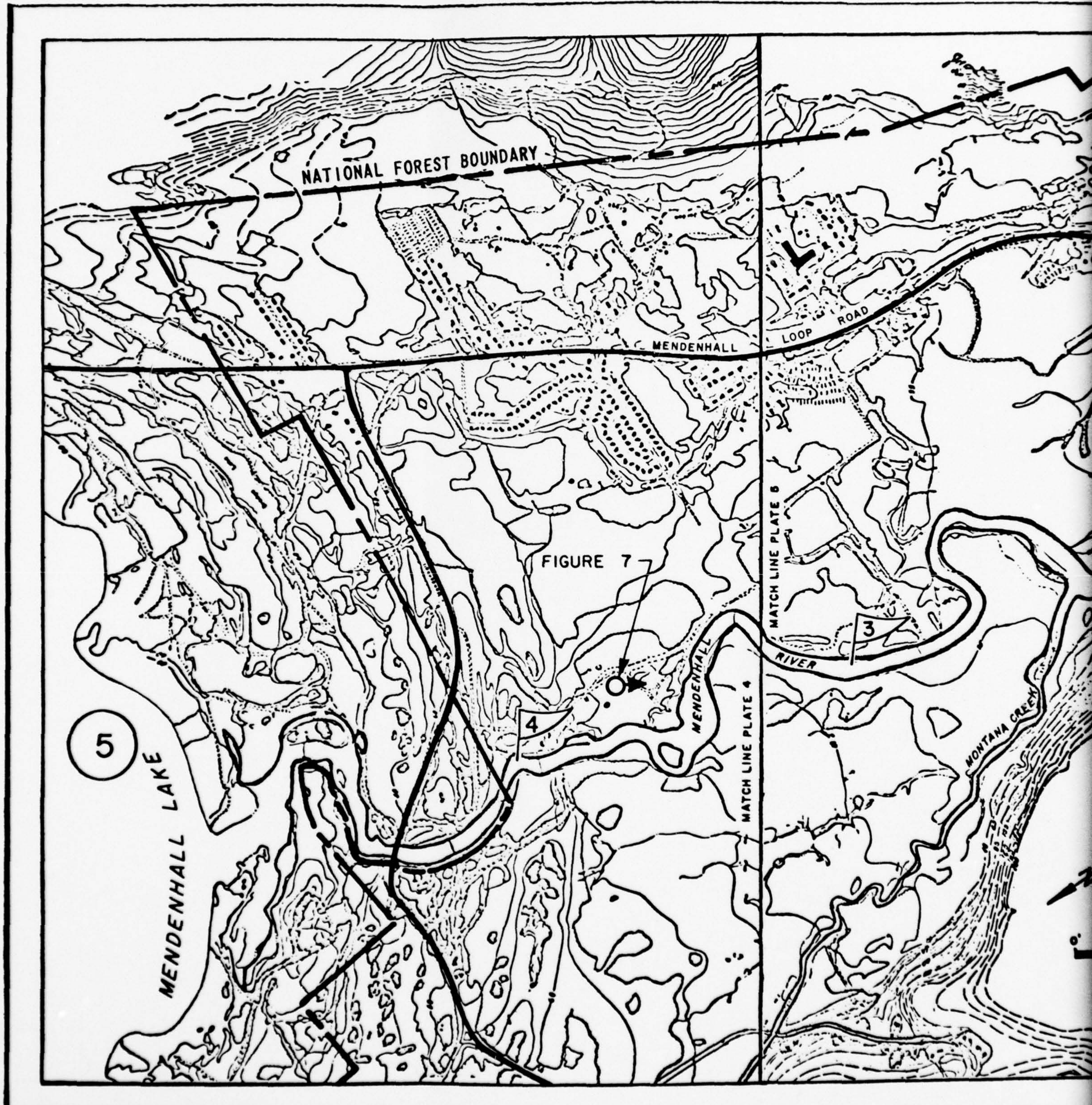
Underclearance. The lowest point of a bridge or other structure over or across a river, stream, or watercourse that limits the opening through which water flows. This is referred to as "low steel" in some regions.

CFS. Cubic Feet per Second is the rate of discharge of a stream whose channel is one square foot in cross-sectional area and whose average velocity is one foot per second.

CM. Corrugated Metal.

CMP. Corrugated Metal Pipe.

RCP. Reinforced Concrete Pipe.



NATIONAL FOREST BOUNDARY
MENDENHALL LOOP ROAD
FIGURE 7
MENDENHALL RIVER
MATCH LINE PLATE 5
MATCH LINE PLATE 4
MONTANA CREEK
MENDENHALL LAKE
5
4
3

1

LEGEND

MILES ABOVE MOUTH

APPROX. NATIONAL FOREST BOUNDARY

PLATE NUMBER

OVERFLOW AREA MAY EXTEND BEYOND LIMIT OF MAP. SEE INDIVIDUAL PLATES.

MENDENHALL RIVER, ALASKA

INDEX MAP
FLOOD PLAIN
INFORMATION STUDY

U.S. ARMY ENGINEER DISTRICT, ALASKA
CORPS OF ENGINEERS

PLATE 2 APRIL 1971

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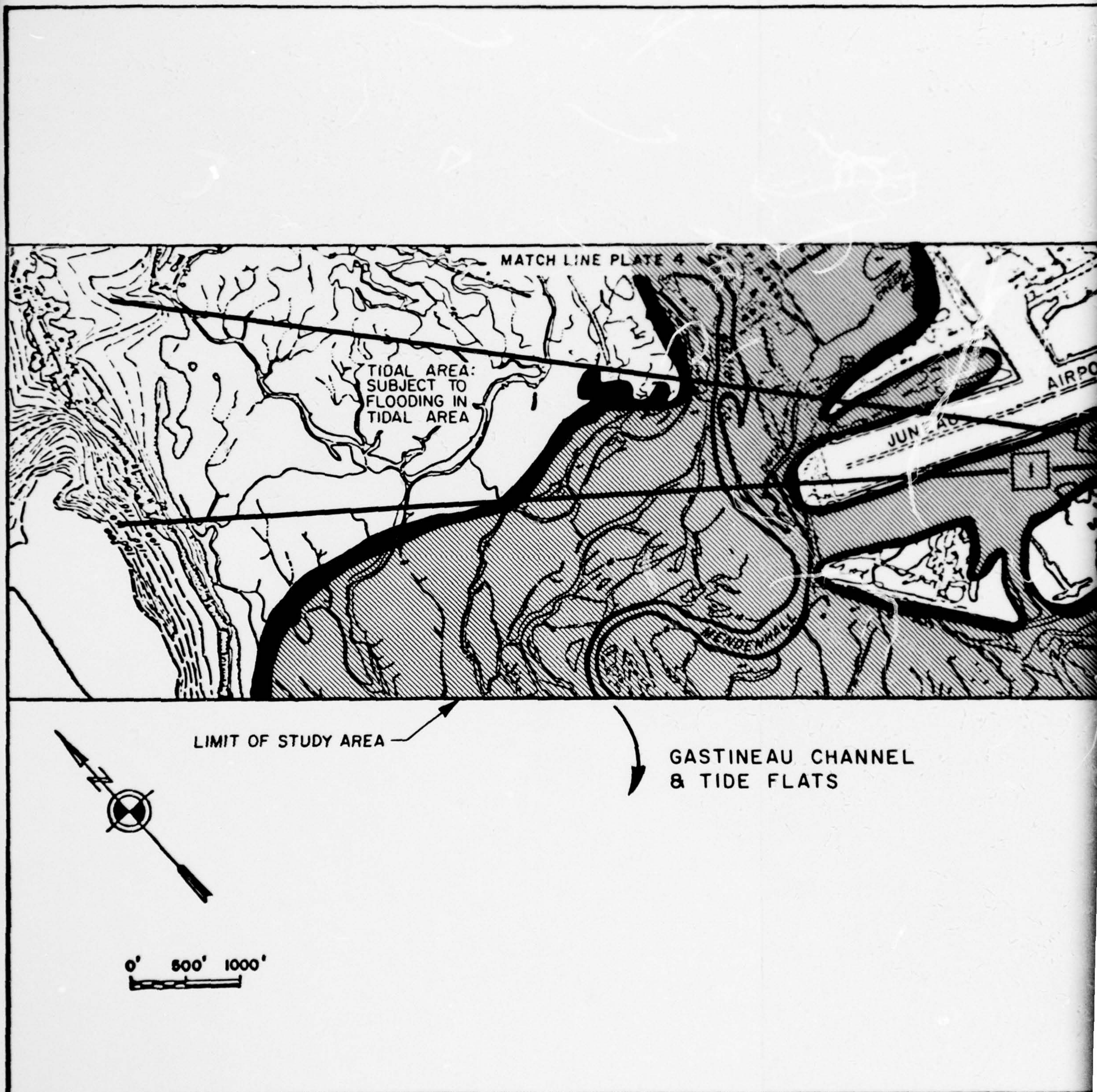
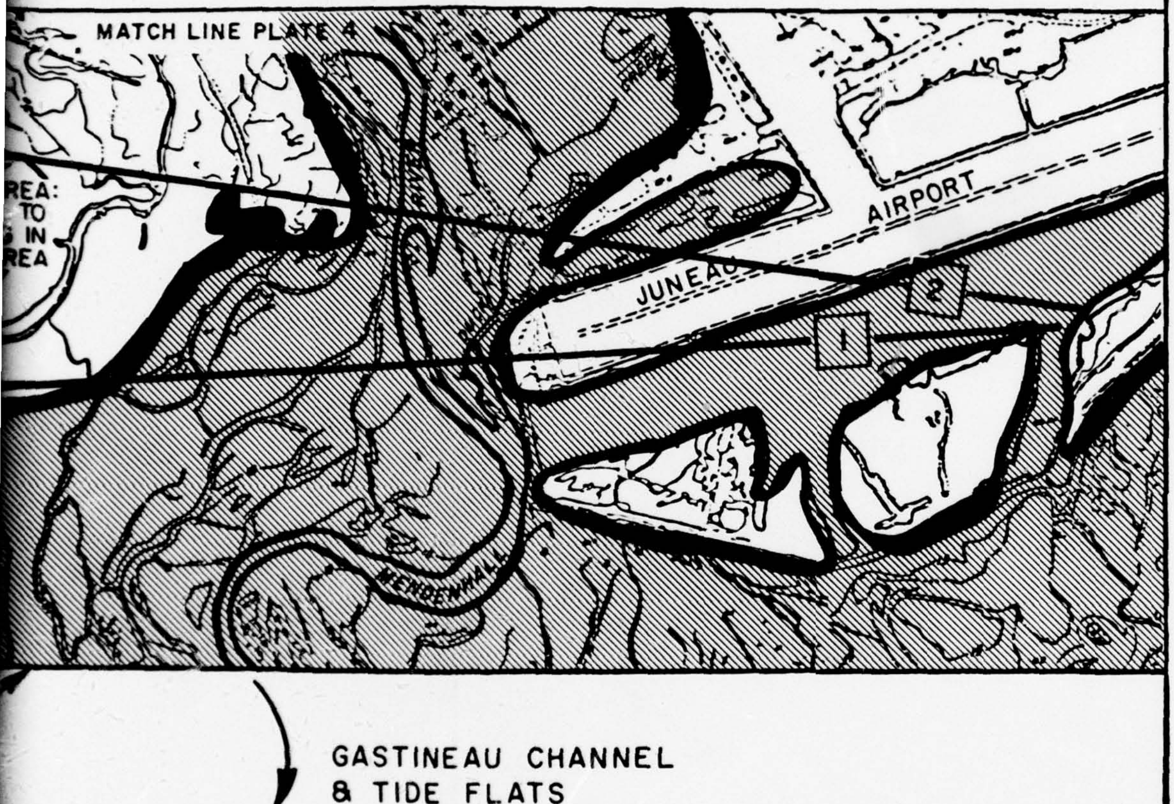
2



MATCH LINE PLATE 4
TIDAL AREA: SUBJECT TO FLOODING IN TIDAL AREA
JUN AU
AIRPO
MENDENHALL
LIMIT OF STUDY AREA
GASTINEAU CHANNEL & TIDE FLATS
N
0' 500' 1000'



LEGEND

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

2 SECTION NUMBER

LIMITS OF OVERFLOW MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN REPORT.

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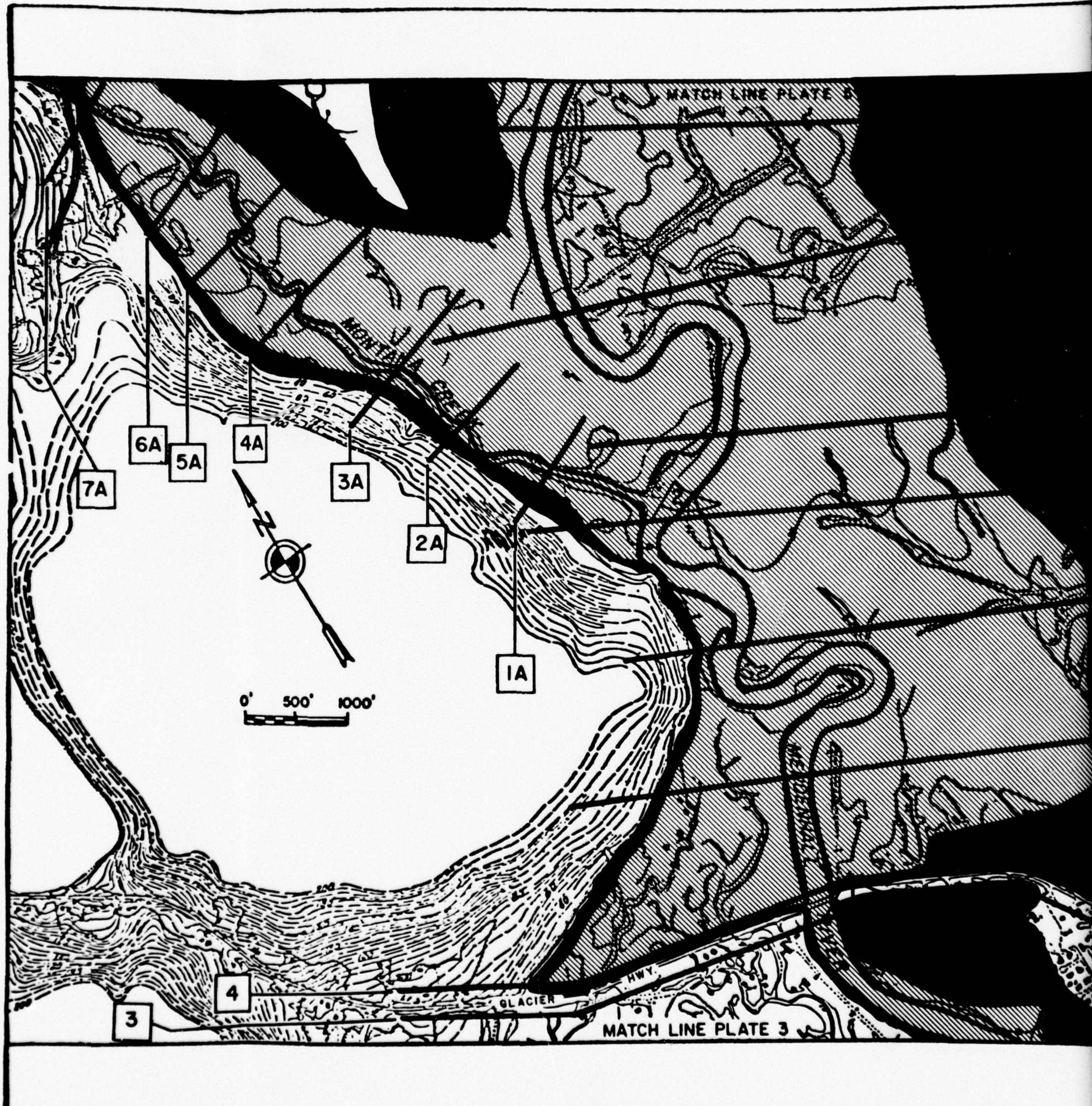
MENDENHALL RIVER, ALASKA

FLOOD PLAIN INFORMATION STUDY

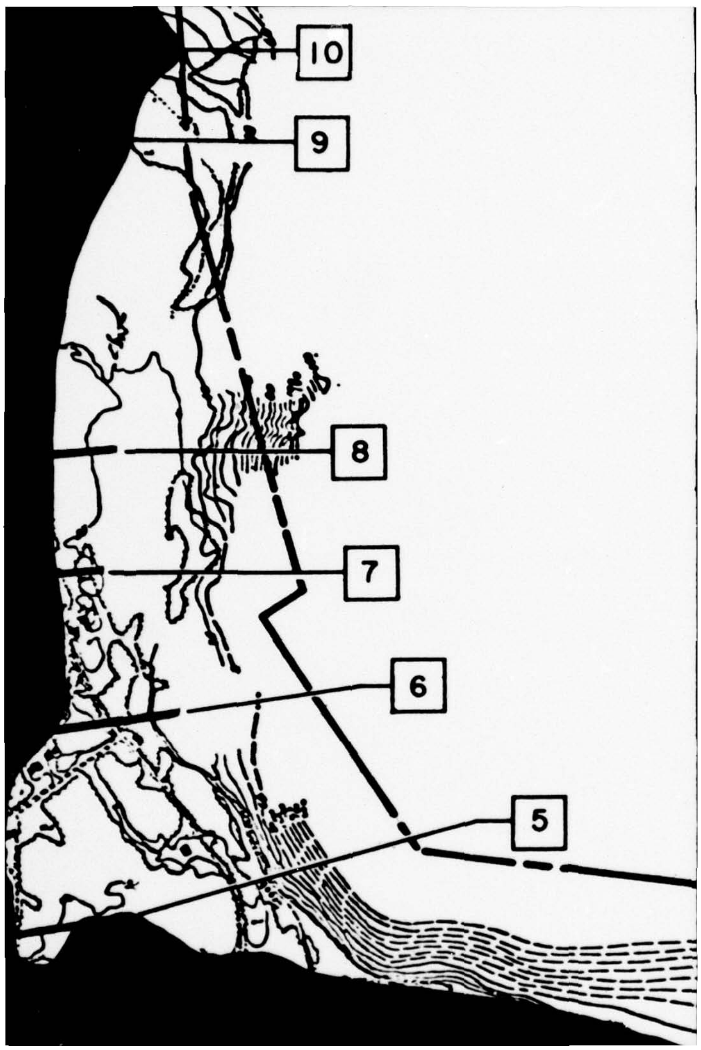
U.S. ARMY ENGINEER DISTRICT, ALASKA
CORPS OF ENGINEERS

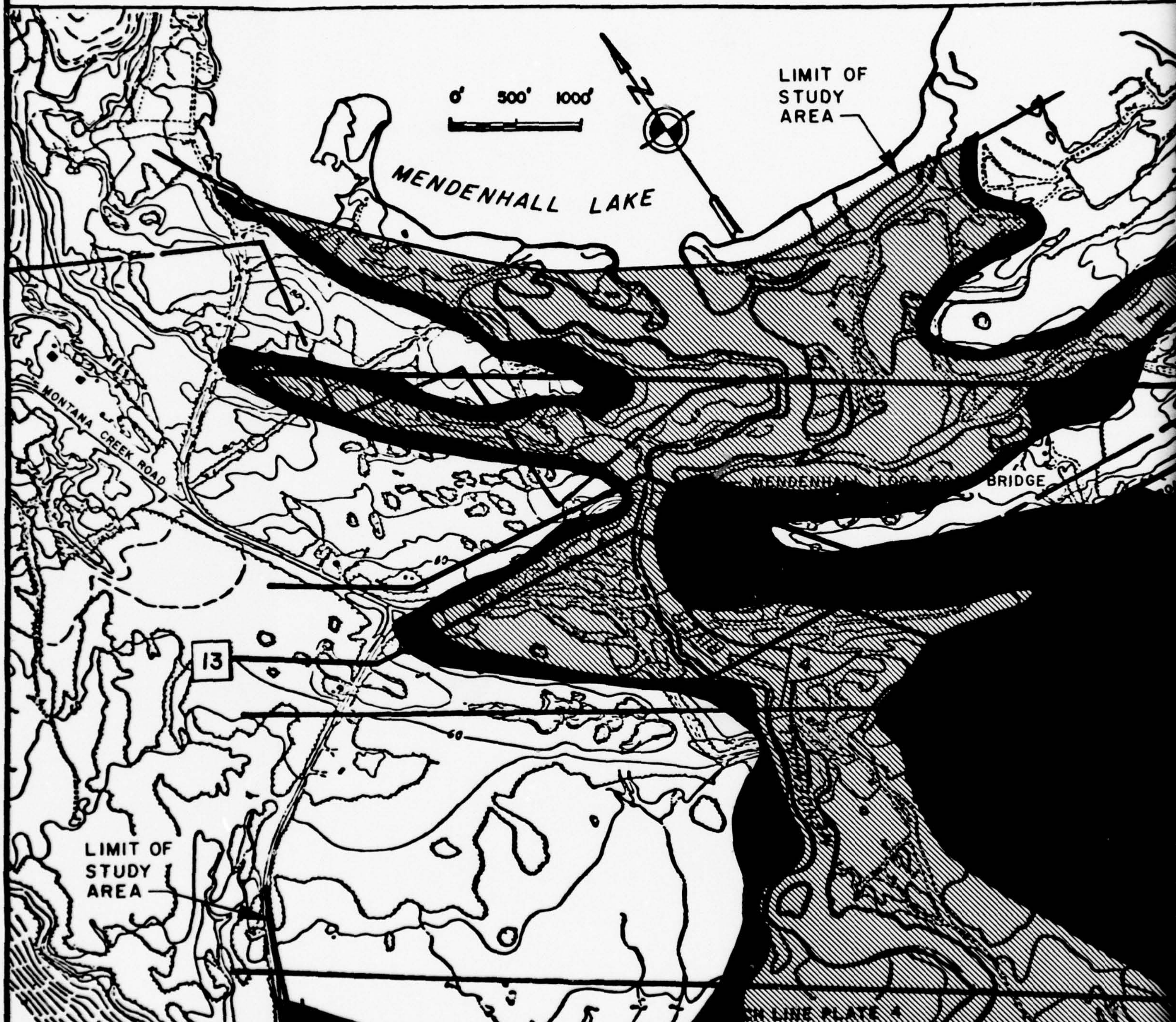
PLATE 3 APRIL 1971



MATCH LINE PLATE 5
MONTANA CREEK
6A
5A
4A
3A
2A
1A
7A
N
0' 500' 1000'
4
3
GLACIER HWY.
MATCH LINE PLATE 3

1


10
9
8
7
6
5



0' 500' 1000'
N
MENDENHALL LAKE
LIMIT OF
STUDY
AREA
MONTANA CREEK ROAD
BRIDGE
13
60
60
LIMIT OF
STUDY
AREA

1

LEGEND

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

2 — SECTION NUMBER

1 — MILES ABOVE MOUTH

APPROX. NATIONAL FOREST BOUNDARY

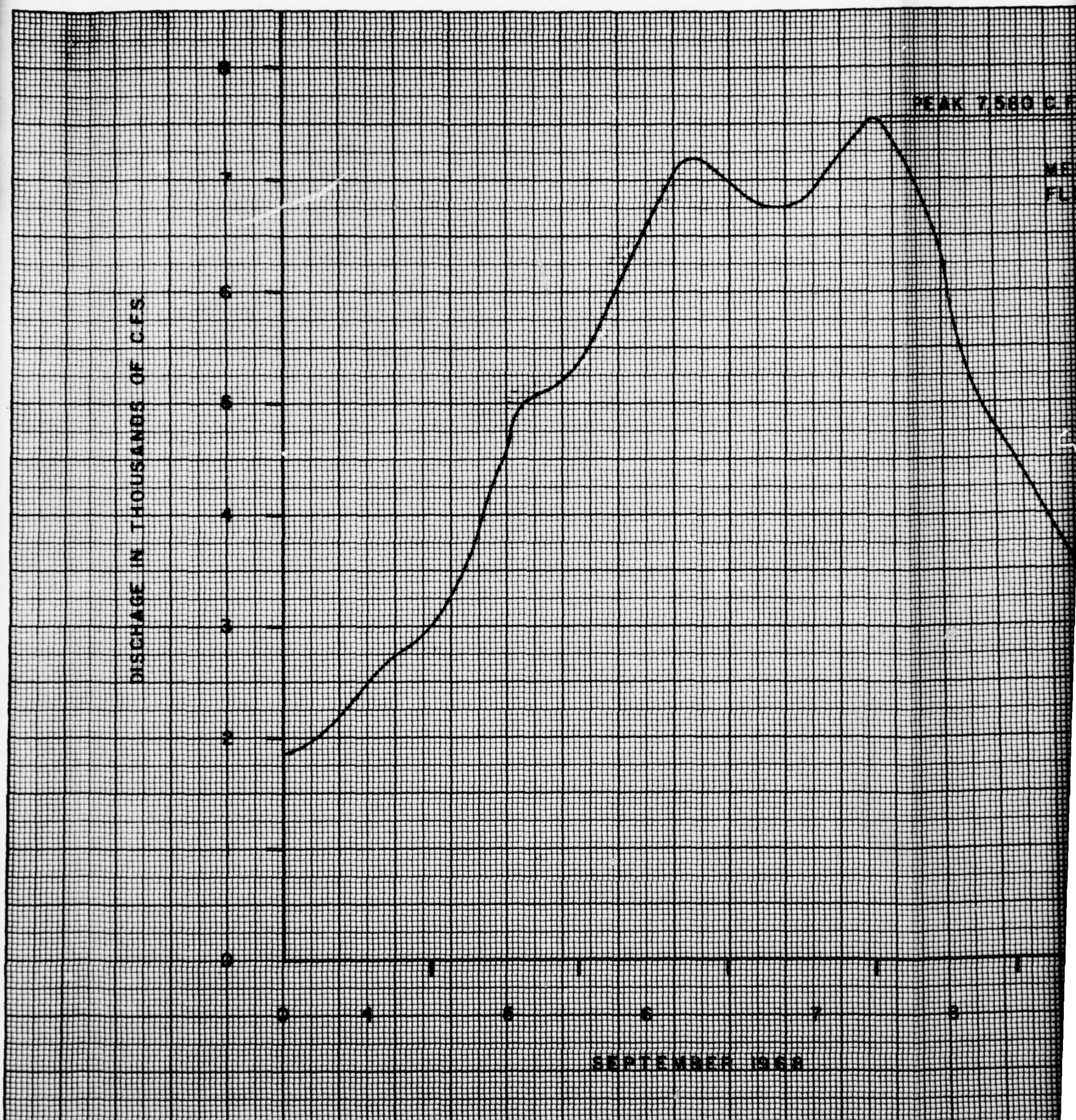
LIMITS OF OVERFLOW MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN REPORT.

MENDENHALL RIVER, ALASKA

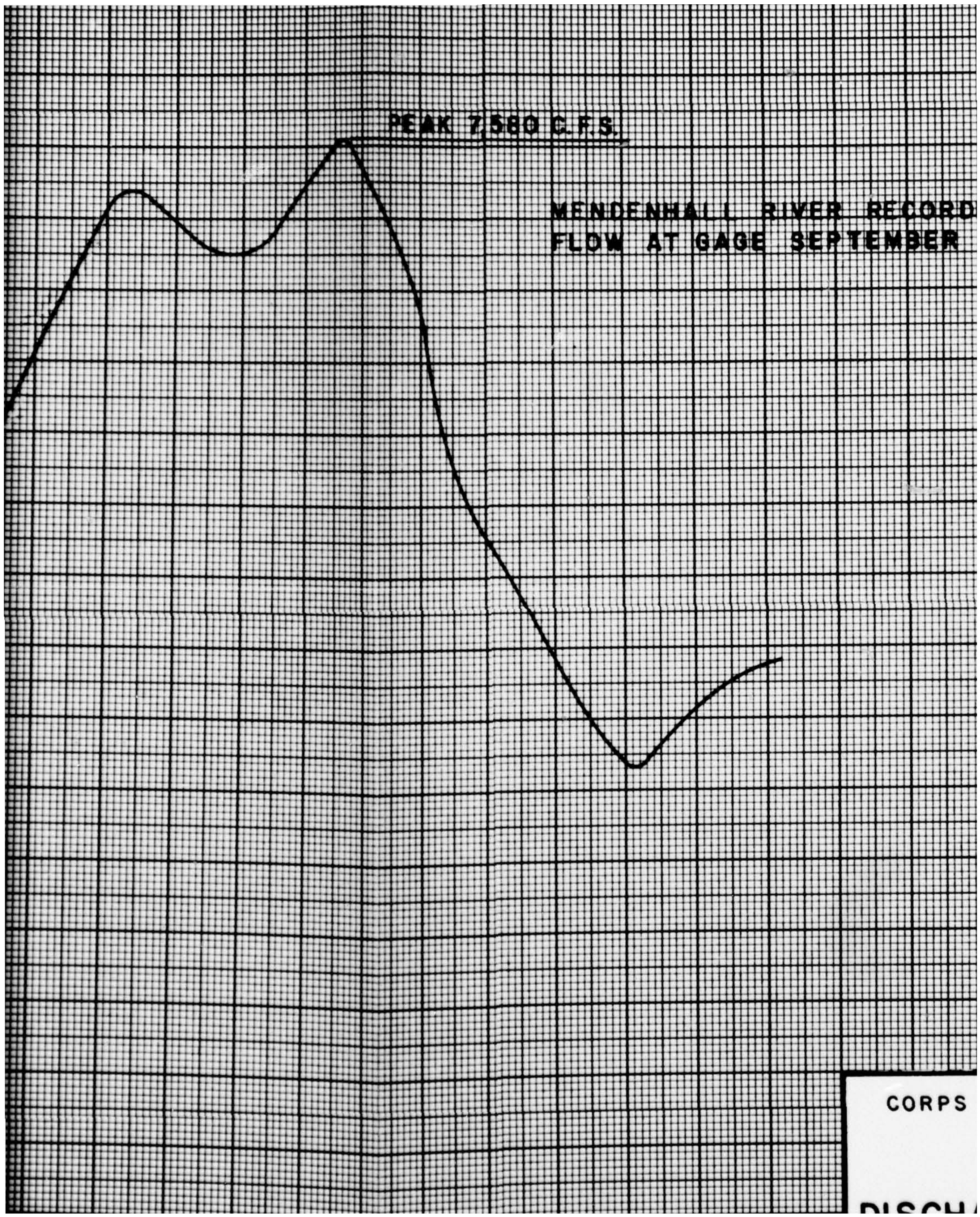
FLOOD PLAIN INFORMATION STUDY

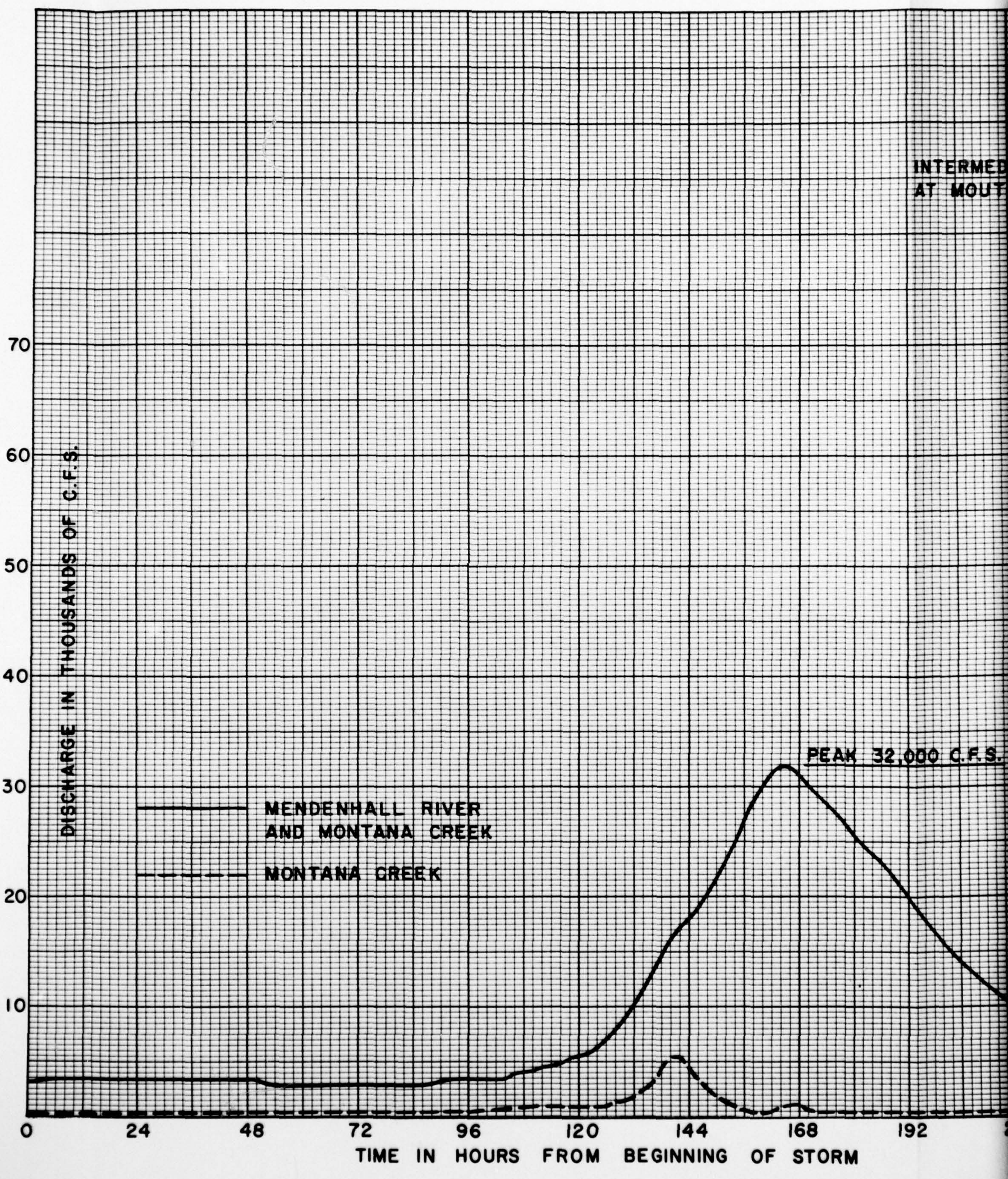
U.S. ARMY ENGINEER DISTRICT, ALASKA
CORPS OF ENGINEERS

PLATE 5 APRIL 1971



PEAK 7,580 C.F
DISCHAGE IN THOUSANDS OF C.F.S.
8
7
6
5
4
3
2
0
4
5
6
7
8
SEPTEMBER 1968


PEAK 7,580 C.F.S.
MENDENHALL RIVER RECORD
FLOW AT GAGE SEPTEMBER
CORPS



INTERMED
AT MOUT
PEAK 32,000 C.F.S.
MENDENHALL RIVER
AND MONTANA CREEK
MONTANA CREEK
DISCHARGE IN THOUSANDS OF C.F.S.
70
60
50
40
30
20
10
0
24
48
72
96
120
144
168
192
TIME IN HOURS FROM BEGINNING OF STORM

1

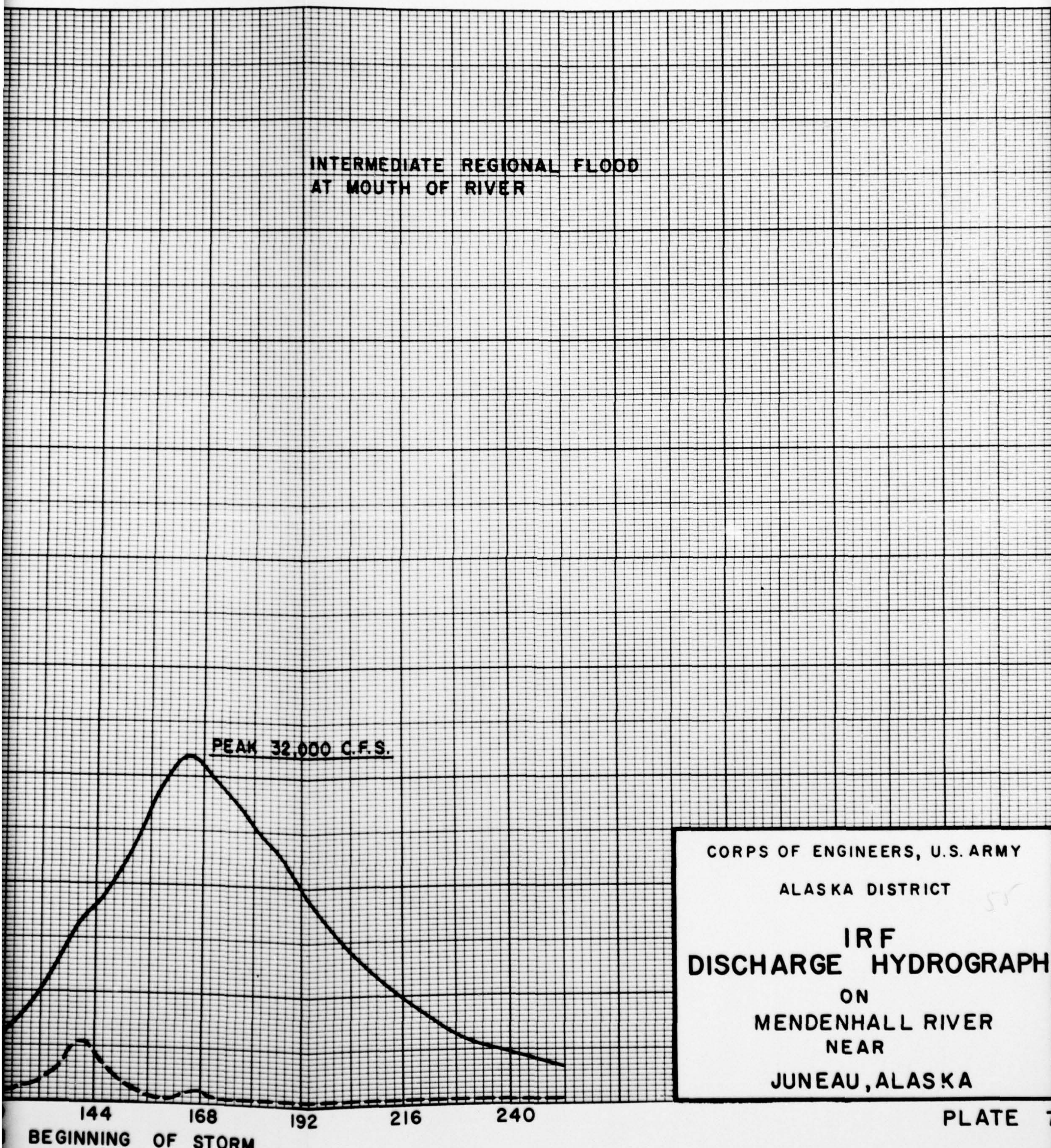
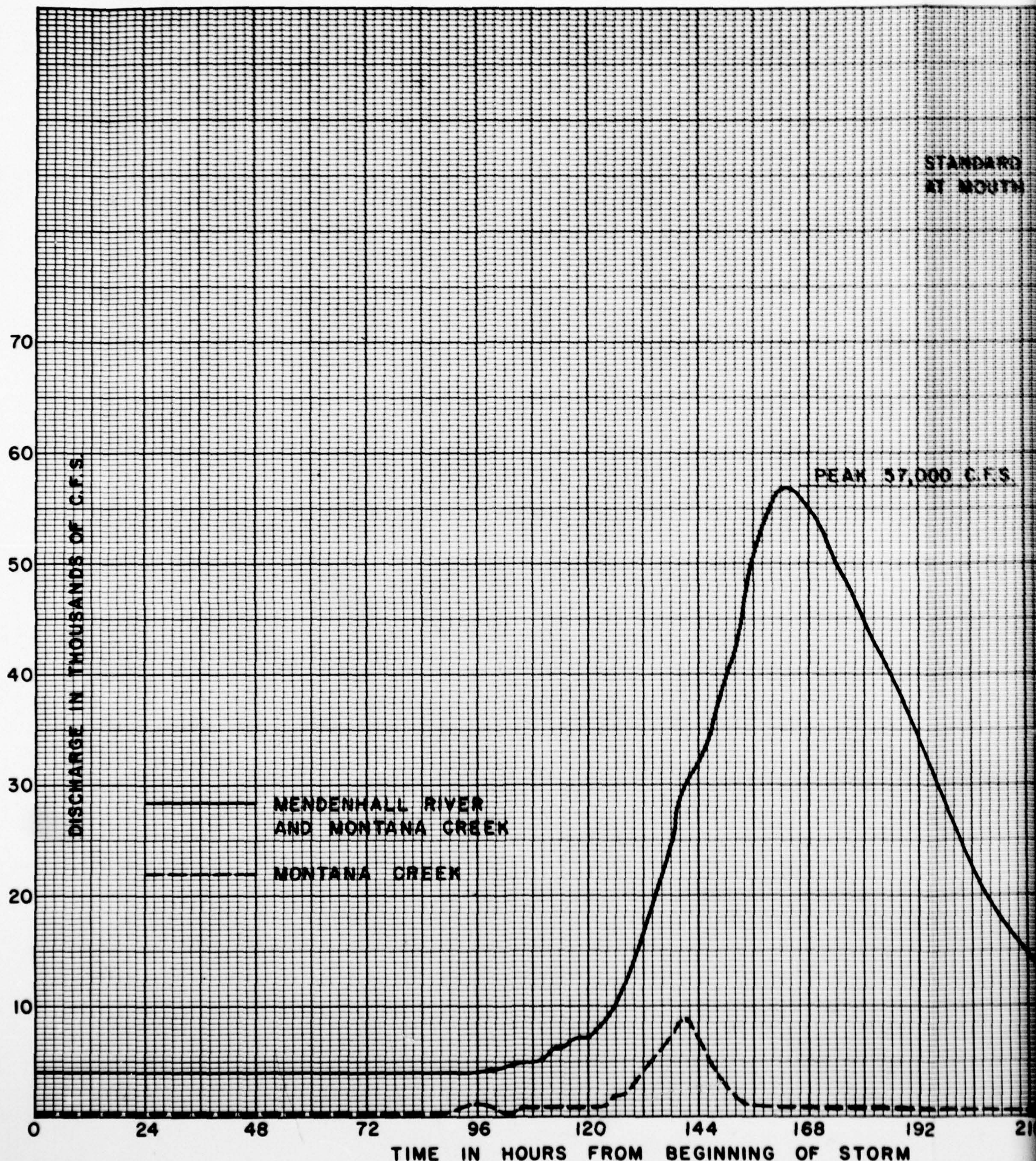
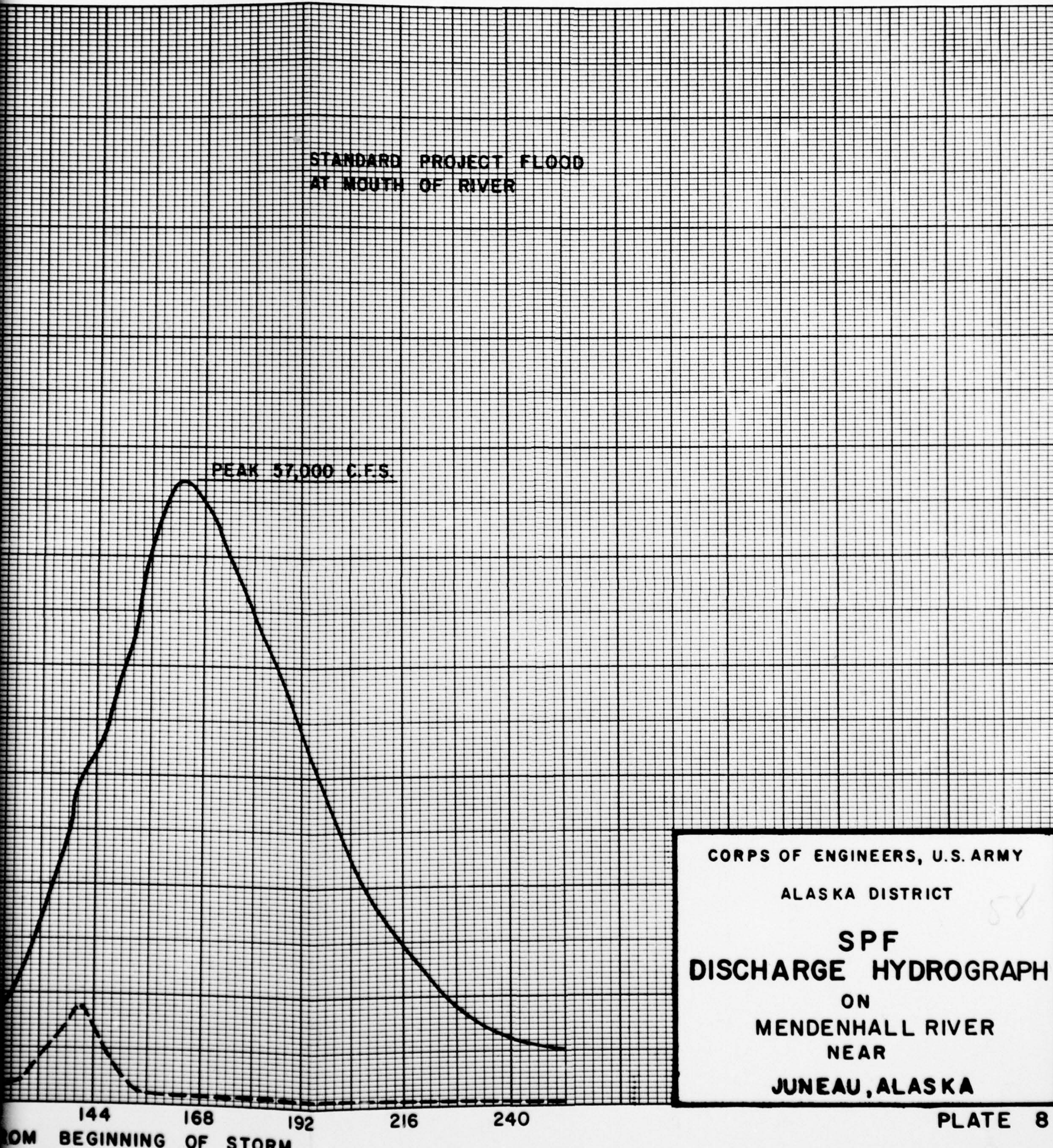

INTERMEDIATE REGIONAL FLOOD
AT MOUTH OF RIVER
PEAK 32,000 C.F.S.
144
168
192
216
240
BEGINNING OF STORM
CORPS OF ENGINEERS, U.S. ARMY
ALASKA DISTRICT
IRF
DISCHARGE HYDROGRAPH
ON
MENDENHALL RIVER
NEAR
JUNEAU, ALASKA

PLATE 7


STANDARD
AT MOUTH
PEAK 57,000 C.F.S.
DISCHARGE IN THOUSANDS OF C.F.S.
70
60
50
40
30
20
10
MENDENHALL RIVER
AND MONTANA CREEK
MONTANA CREEK
0
24
48
72
96
120
144
168
192
TIME IN HOURS FROM BEGINNING OF STORM
1

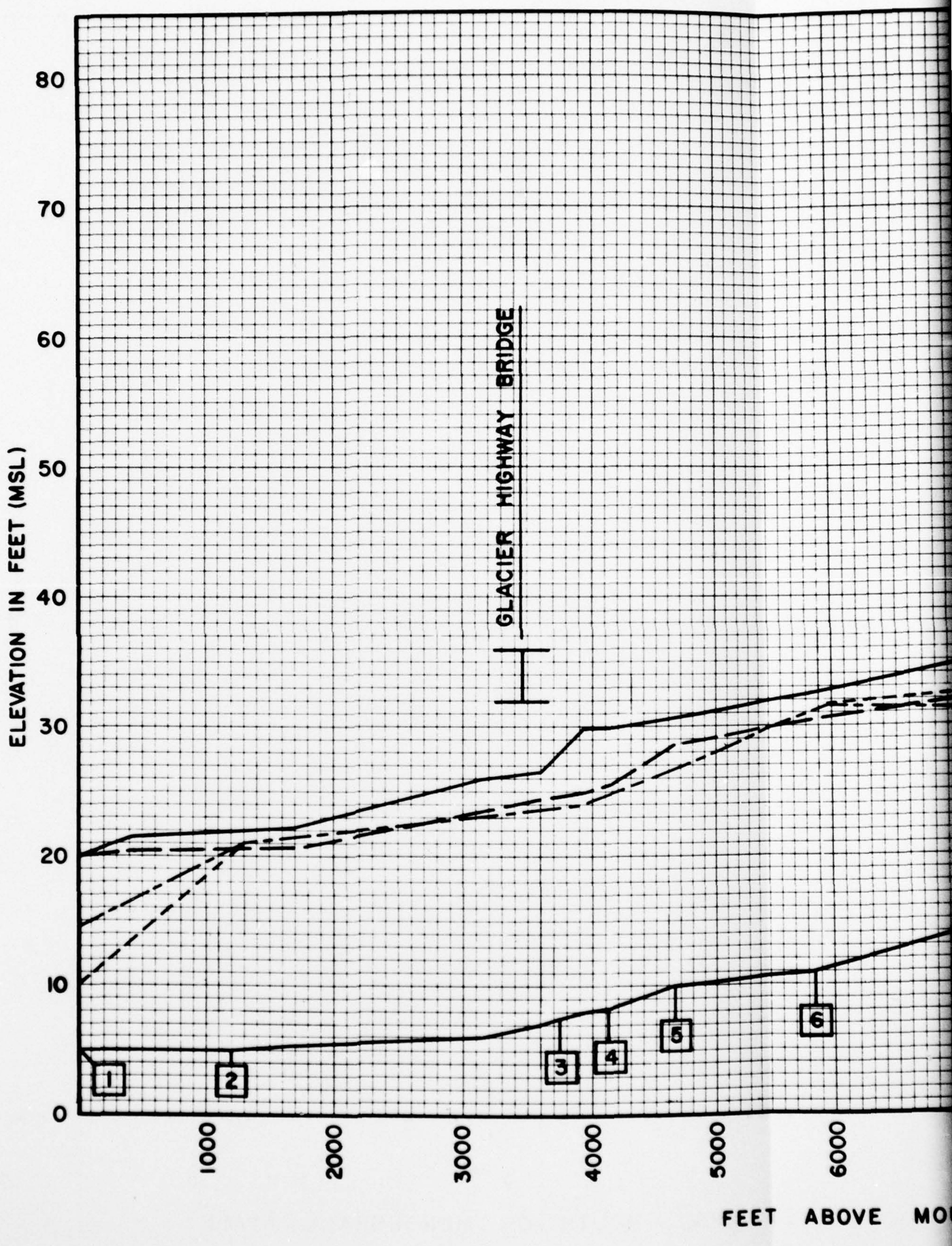


CORPS OF ENGINEERS, U.S. ARMY

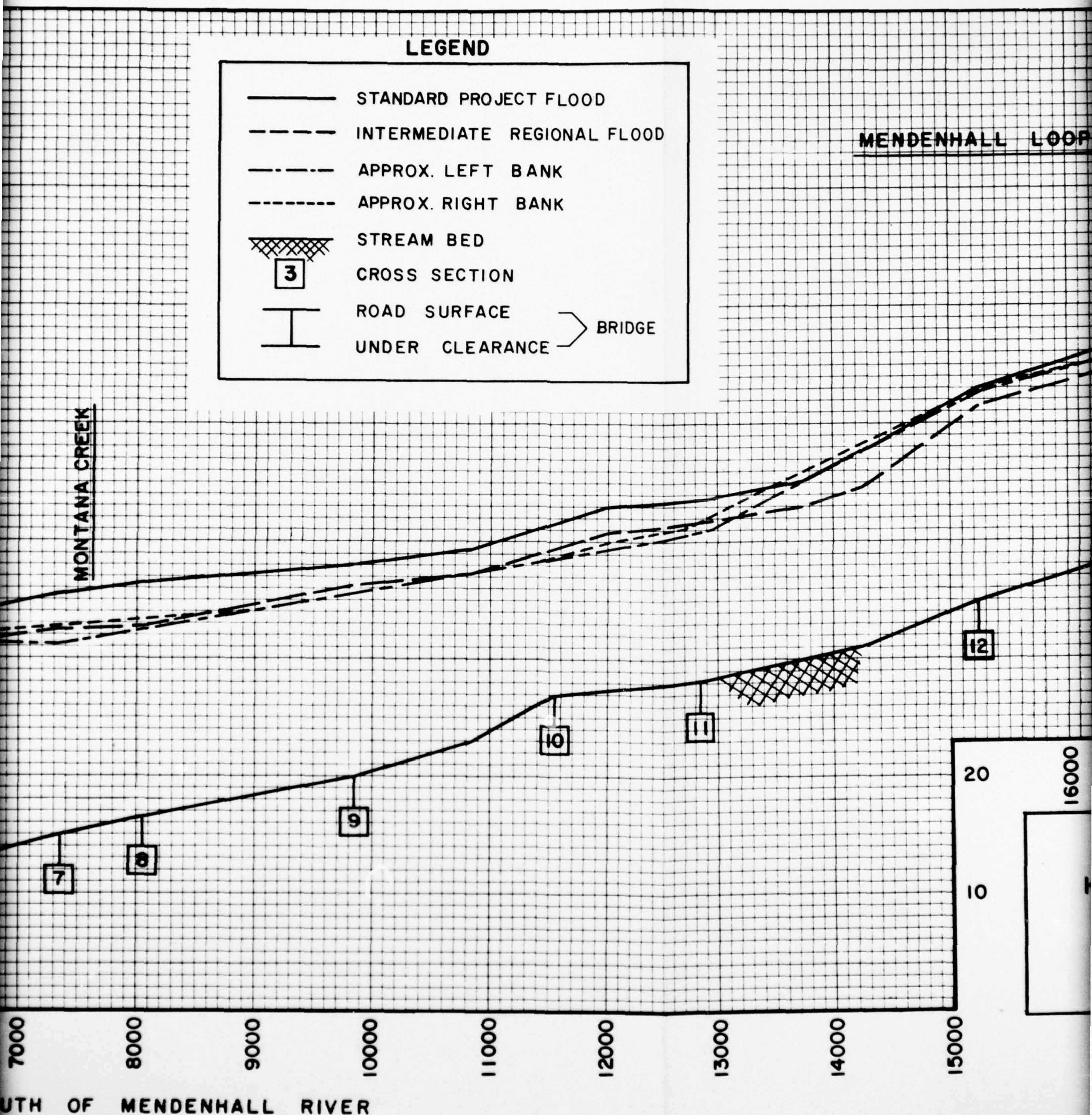
ALASKA DISTRICT

SPF
DISCHARGE HYDROGRAPH
ON
MENDENHALL RIVER
NEAR
JUNEAU, ALASKA

PLATE 8

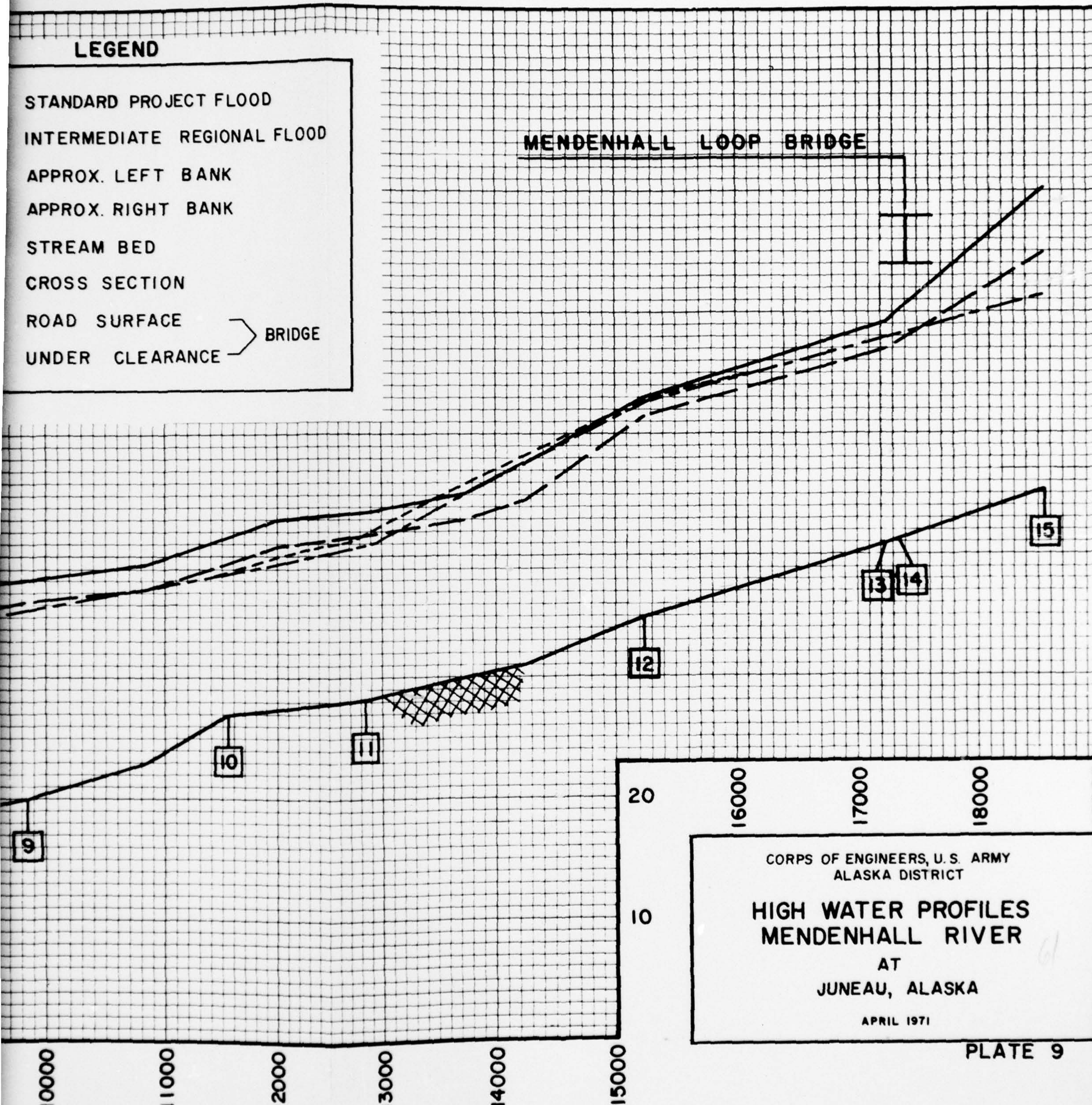

ELEVATION IN FEET (MSL)
80
70
60
50
40
30
20
10
0
GLACIER HIGHWAY BRIDGE
1
2
3
4
5
6
1000
2000
3000
4000
5000
6000
FEET ABOVE MO

/



LEGEND
STANDARD PROJECT FLOOD
INTERMEDIATE REGIONAL FLOOD
APPROX. LEFT BANK
APPROX. RIGHT BANK
STREAM BED
3
CROSS SECTION
ROAD SURFACE
UNDER CLEARANCE
BRIDGE
MENDENHALL LOOP
MONTANA CREEK
7
8
9
10
11
12
20
10
16000
7000
8000
9000
10000
11000
12000
13000
14000
15000
UTH OF MENDENHALL RIVER

2

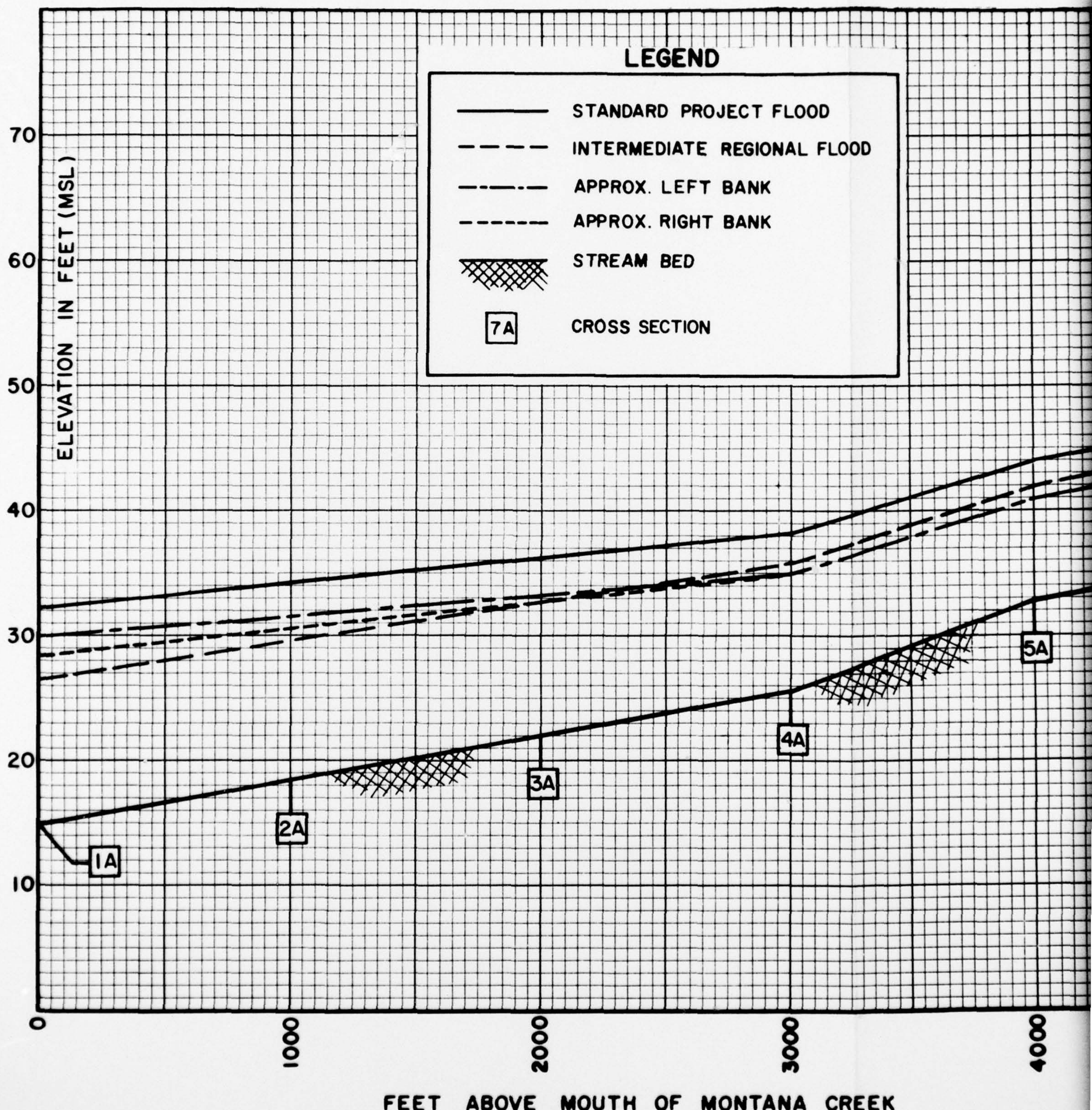


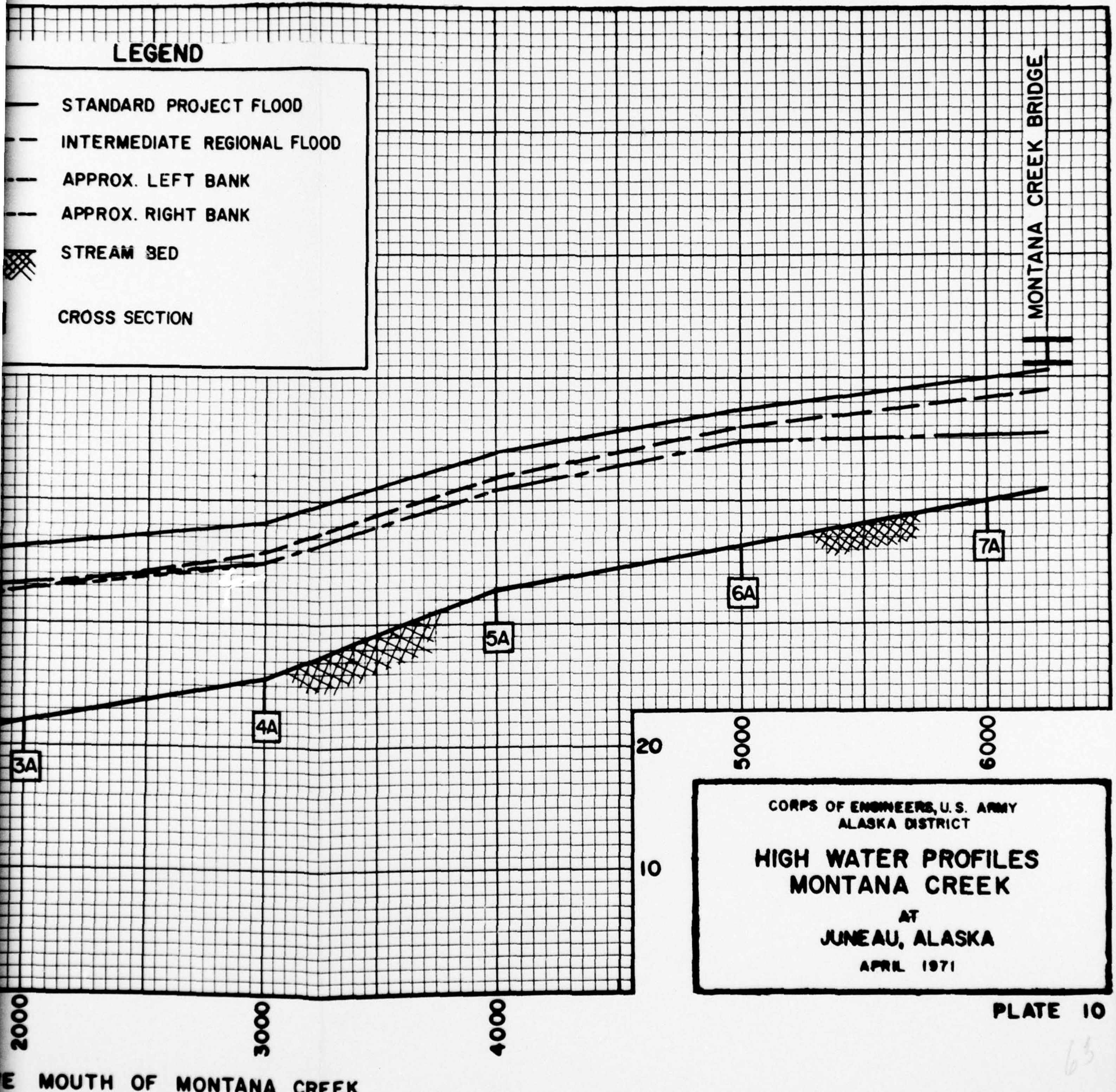
CORPS OF ENGINEERS, U.S. ARMY
ALASKA DISTRICT

HIGH WATER PROFILES
MENDENHALL RIVER
AT
JUNEAU, ALASKA

APRIL 1971

PLATE 9


LEGEND
STANDARD PROJECT FLOOD
INTERMEDIATE REGIONAL FLOOD
APPROX. LEFT BANK
APPROX. RIGHT BANK
STREAM BED
7A
CROSS SECTION
ELEVATION IN FEET (MSL)
70
60
50
40
30
20
10
1A
2A
3A
4A
5A
0
1000
2000
3000
4000
FEET ABOVE MOUTH OF MONTANA CREEK



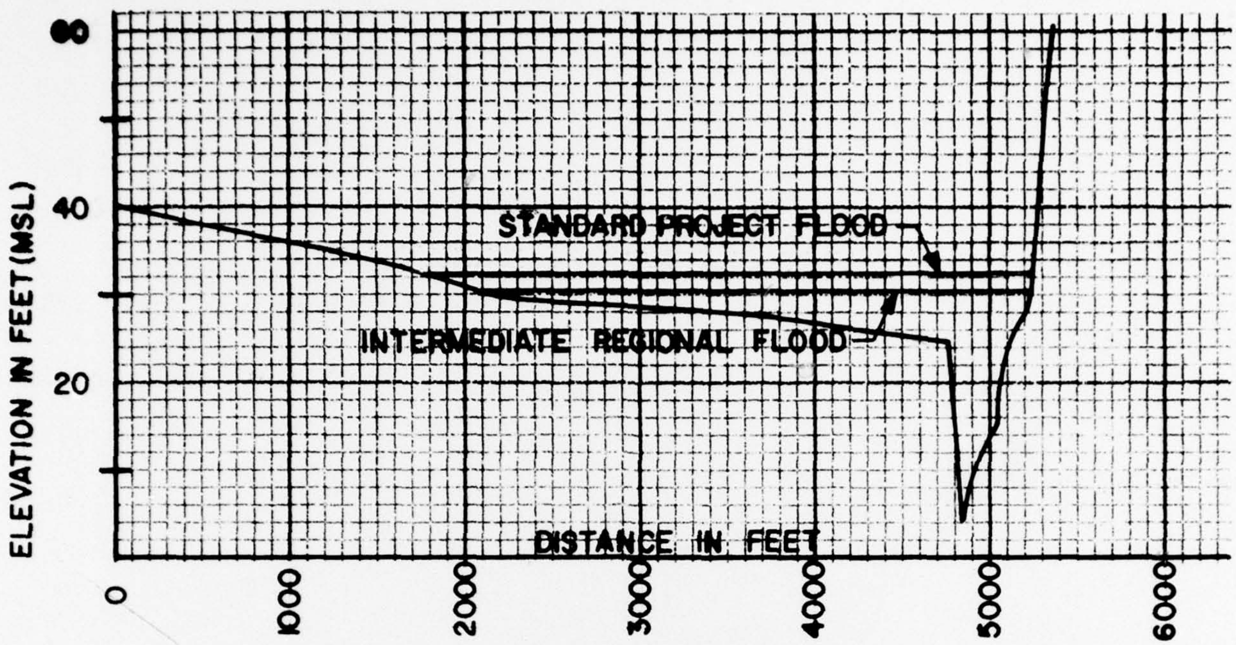
CORPS OF ENGINEERS, U.S. ARMY
ALASKA DISTRICT

HIGH WATER PROFILES
MONTANA CREEK
AT
JUNEAU, ALASKA

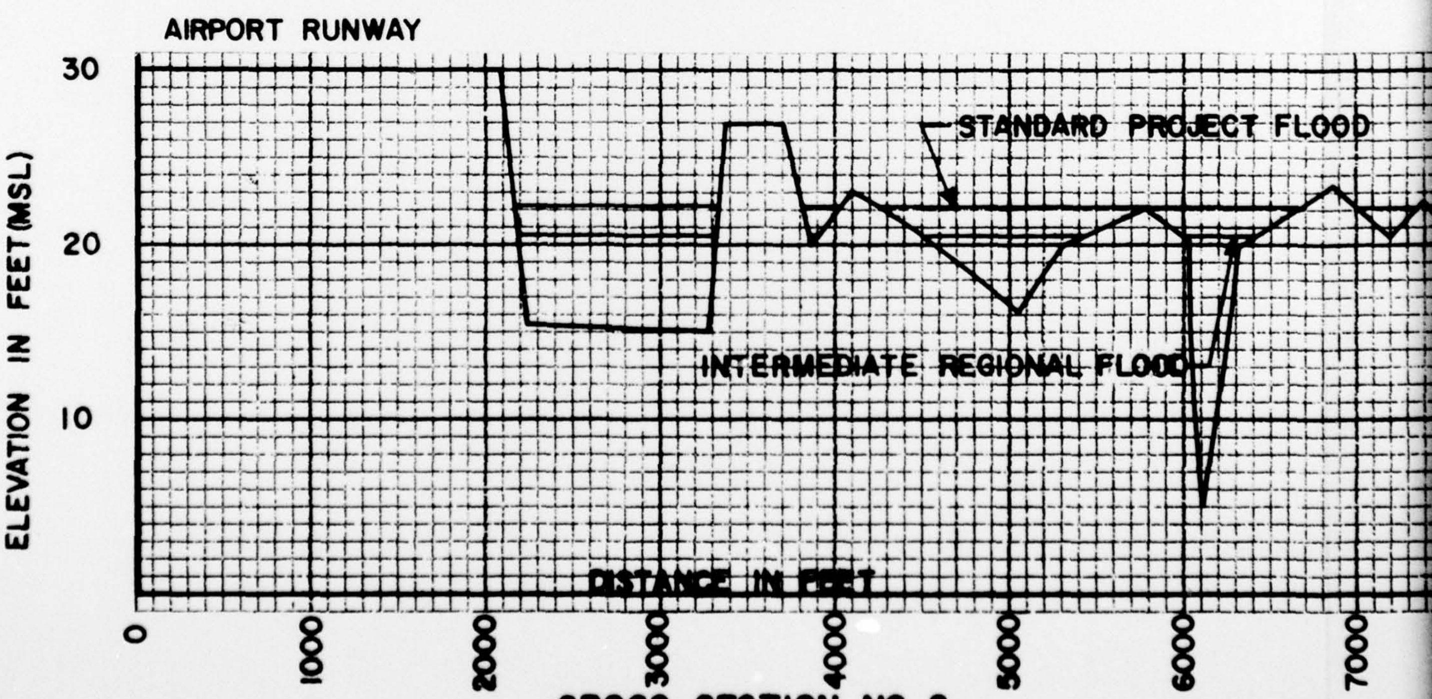
APRIL 1971

PLATE 10

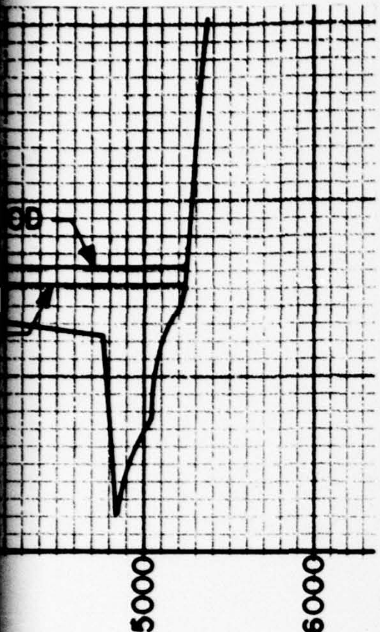
63



CROSS SECTIONS NO. 6



CROSS SECTION NO. 2



D.6

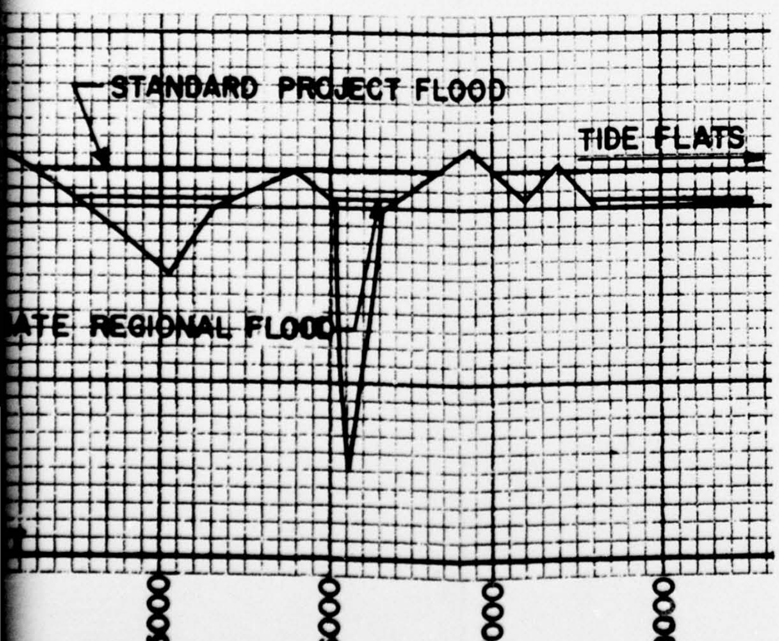
NOTES:

1. SEE FLOOD PLAIN MAP AND HIGH WATER PROFILE FOR AREAS AND DEPTHS OF FLOODING.

2. SEE PLATES 3 AND 4 FOR LOCATION OF CROSS SECTIONS.

3. CROSS SECTIONS SHOWN LOOKING DOWNSTREAM.

4. STANDARD PROJECT FLOOD - 57,000 C.F.S.
   INTERMEDIATE REGIONAL FLOOD - 32,000 C.F.S.



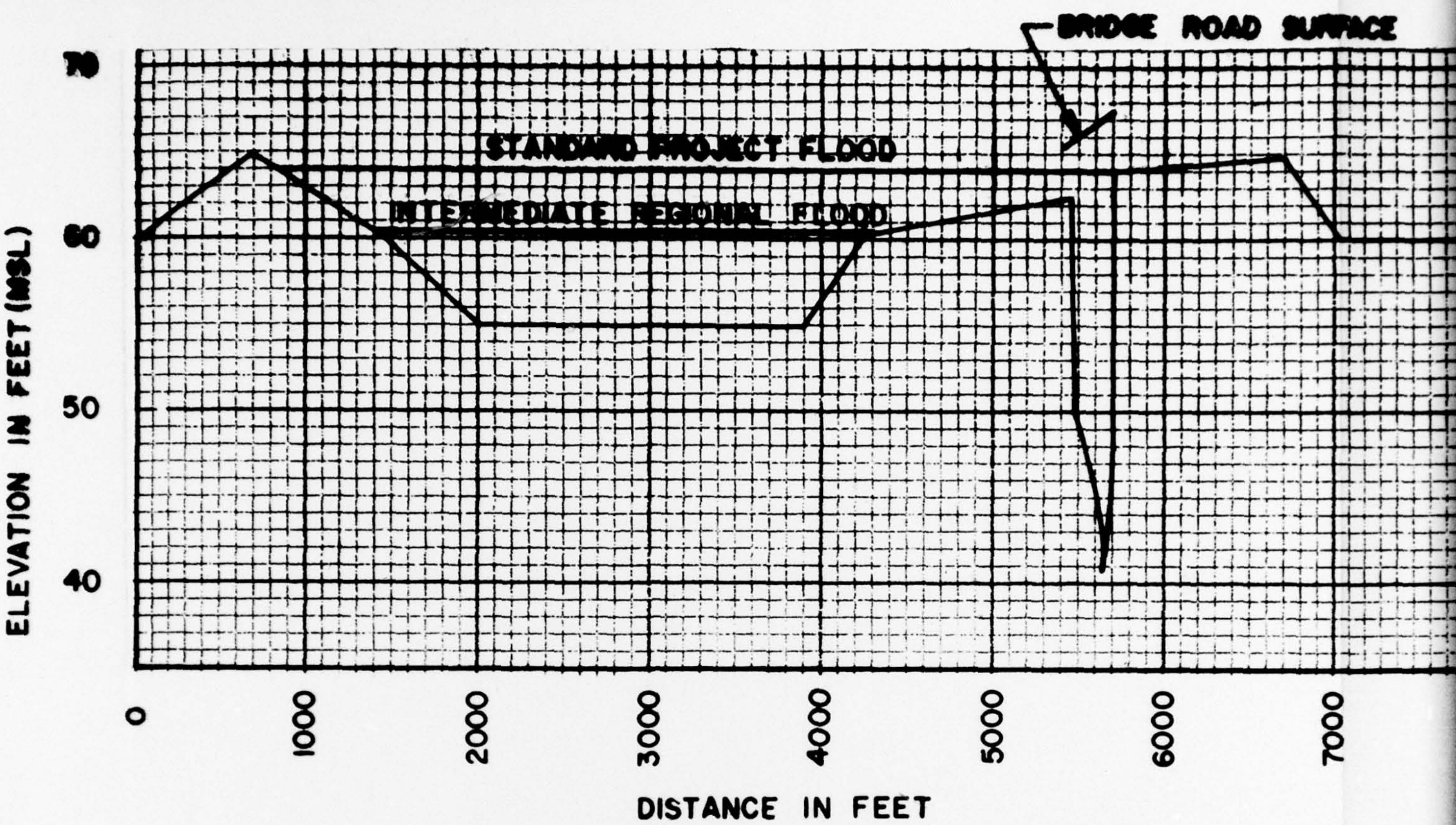
NO. 2

CORPS OF ENGINEERS, U.S. ARMY
ALASKA DISTRICT

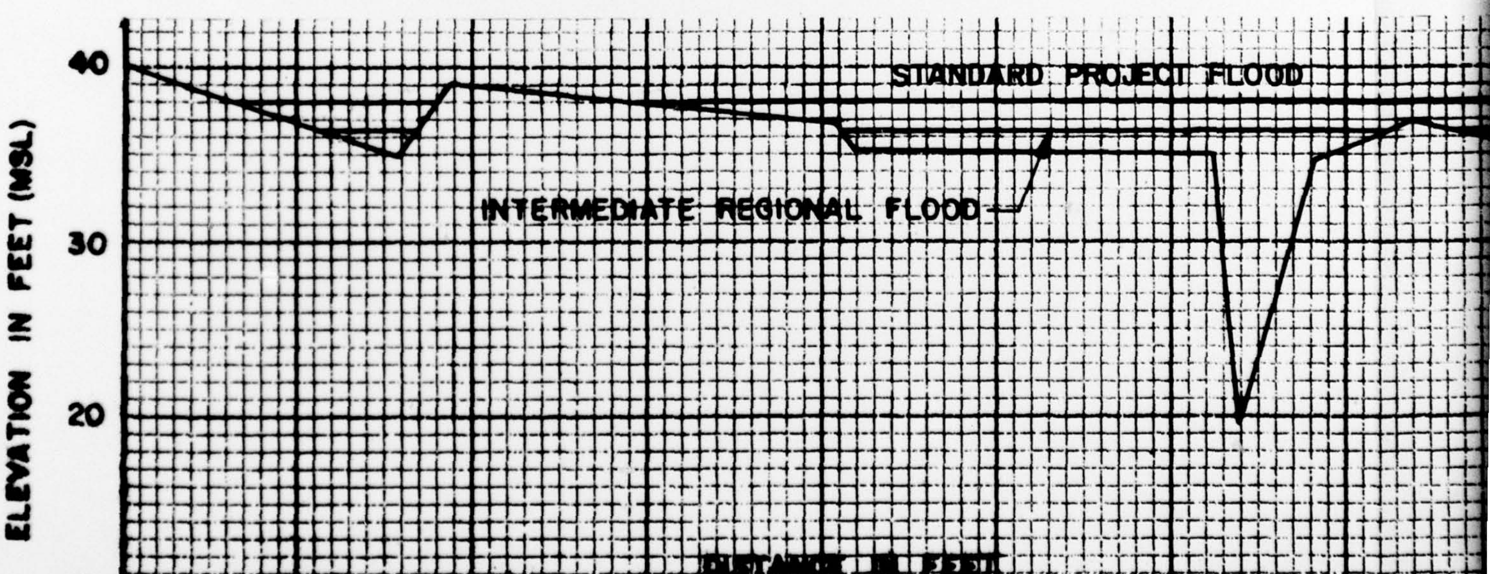
TYPICAL CROSS SECTIONS
MENDENHALL RIVER
AT
JUNEAU, ALASKA

APRIL 1971

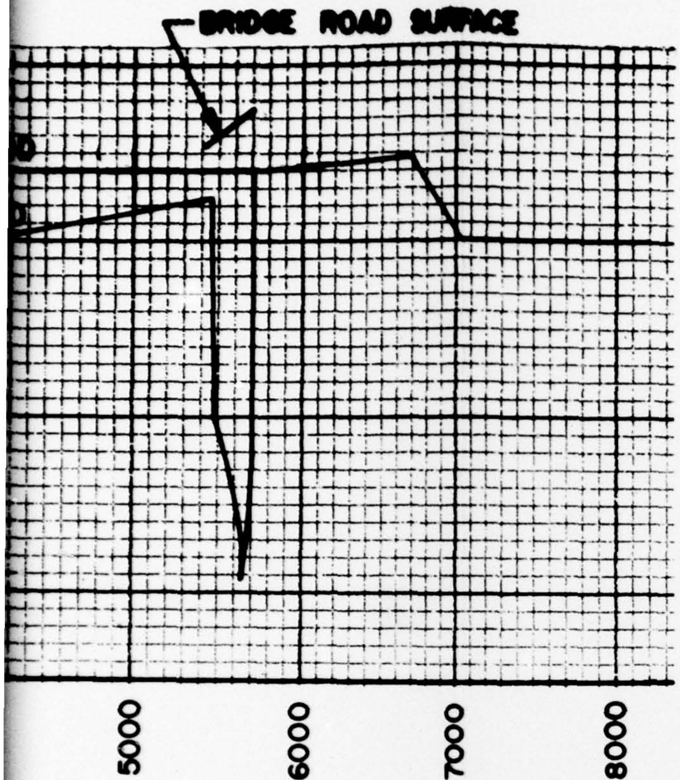
PLATE 11



LOOP ROAD BRIDGE CROSS SECTIONS

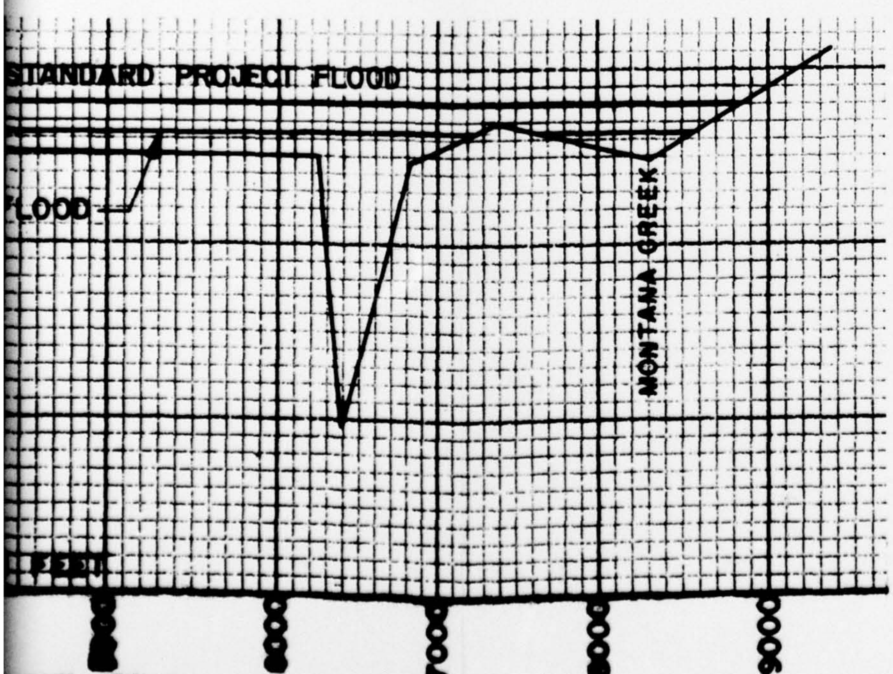


CROSS SECTION NO. 9



EET

ROSS SECTIONS



TION NO. 9

NOTES:

1. SEE FLOOD PLAIN MAP AND HIGH WATER PROFILE FOR AREAS AND DEPTHS OF FLOODING.

2. SEE PLATES 4 AND 5 FOR LOCATION OF CROSS SECTIONS.

3. CROSS SECTION SHOWN LOOKING DOWNSTREAM.

4. STANDARD PROJECT FLOOD - 57,000 C.F.S.
INTERMEDIATE REGIONAL FLOOD - 32,000 C.F.S.

CORPS OF ENGINEERS, U.S. ARMY
ALASKA DISTRICT

TYPICAL CROSS SECTIONS
MENDENHALL RIVER
AT
JUNEAU, ALASKA

APRIL 1971

PLATE 12